Chapter Five – Environmental Consequences

AFFECTED ENVIRONMENT

5.1 Chapter Introduction and Organization

This chapter of the DEIS presents a description of the impacts of the No-build and build alternatives on the natural and human environment. Measures to minimize harm and/or mitigate project impacts are also discussed.

Chapter Organization:

Environmental impacts are described in Chapter 5 and are grouped into three main categories:

- Section 5.2 - the Natural Environment,
- Section 5.3 - the Social Environment, and
- Section 5.4 - Cultural Resources.

For each of these environments, the impacts attributable to this proposed section of I-66 from Somerset to London are presented by alternative and include discussions of avoidance, minimization and mitigation efforts.

5.1.1 Alternatives Considered for Impacts

The No-build Alternative

As the name implies, the no-build alternative consists of no actions in the project area. The No-build alternative involves not constructing the I-66 segment from Somerset to London and continuing to use existing transportation facilities, as they exist today. The No-build alternative would have no direct impacts to the environment. However, this alternative would not meet the purpose and need of the proposed action. The No-Build Alternative would not meet the primary goal of the project, which is completing a segment of Interstate 66. This alternative would also not address the predicted deficiencies in the LOS for existing KY80, geometrics involving at-grade intersections, and highway system linkages in the area transportation network. Additionally, this alternative would not improve access to the area, or increase opportunities for economic development. A cumulative effect of this selection could be an increase in travel time for area residents within the region and to larger population centers, increased fuel consumption for motorists, and decreased economic opportunities for area residents and businesses.

The Build Alternatives

Eleven build alternatives were described and shown in Chapter 3 of this document. The alternatives evaluated for environmental impacts presented in this chapter are as follows:

Pulaski County Alternatives

- KY80 Modified
- KY80 Shifted
- B
- D
- B-D
- K

Laurel County Alternatives

- G
- H
- I
- L
- M

The impacts of each alternative are discussed in detail in this chapter. For summary impact tables for all resources, by alternative, see the alternatives discussion in Chapter 3.

5.2 Impacts to the Natural Environment

5.2.1 Soil Hazard Impacts

The occurrence of slide prone and unsuitable soils is widespread within both Pulaski and Laurel Counties. The KGS has identified the slide-prone soils and many active landslides. [See Gannet Fleming (October 2004) for slide prone soil sites within the study bands] The possibility of providing an alignment without encountering the slide prone geologic strata unlikely. The consequences of poor rock and unsuitable soils are basically restricted to utilizing flatter slopes or designed catchments. Landslides are known in surface mine spoil piles, natural soil slopes, and constructed embankments. The presence of the unsuitable soils may require blending of desirable excavated material with the poorer soils to produce an acceptable embankment construction material. Rock falls are identified along several portions of KY80 and other routes. The rock slope failures can be avoided with effective slope benching, catchment, or rock anchoring options.

5.2.2 Potential Coal Impacts

The presence of coal or other valued minerals within the project area presents two differing types of impacts; economical and physical. Since there are known coal resources in the study area, cost to acquire ROW may be increased due to the need to purchase the mineral rights to the land as well. A valuation study is often required to determine the extent of the minable mineral resource on a property and thereby determine a fair market value for the land.

Although most active coal mining in the study area has ceased; mining impacts remain. Underground mines present several potential hazards to a transportation project including:

- Potential for mine subsidence affecting roadway or structures with catastrophic results.
- Potential for the uncontrolled release of mine drainage water if a road cut exposes an abandoned mine.
- Additional construction cost for mitigating exposed mine workings or subsidence potential of underground mines and/or treatment of mine drainage.

Surface mines present different potential impacts than underground mines. In surface mine operations, overburden (soil and rock) is excavated by very large equipment and 'cast' behind the working face of the coal. These cast piles, even if reclaimed, essentially consist of non-engineered fills. Special treatment of the non-engineered fills associated with this type of mining and reclamation are sometimes required to prevent detrimental, differential settlement from affecting highway pavements and structure foundations. Additionally, abandoned strip mines are often sources of acid mine drainage (AMD) and use of the area may require active or passive treatment of the AMD discharge.

According to records of the Kentucky Department for Surface Mining, there are no historical acid mine drainage occurrences in the project area, and the project area is in a region which the U. S. Geological Survey considers to have low potential for acid mine drainage (USGS 2002). However, low pH readings were recorded during field studies for this project from two tributaries to Lacey Fork near the community of Squib. These acid water conditions are undoubtedly the result of mining of the Halsey Rough coal bed in the vicinity. This coal bed has been worked extensively in recent years, both by underground mining and by stripping (Hatch 1963b). In this area, the Halsey Rough coal bed occurs in numerous locations from just west of the Rockcastle River to just east of Price Valley School in the basins of Lacey Fork, Clifty Creek, and Line Creek. All of the alternatives have about an equal likelihood of encountering this coal bed, and any roadway cuts which expose this coal bed or waste material of former mining operations have the potential of creating or worsening acid runoff. Avoiding, controlling and/or treating acid runoff will be addressed during final design.

5.2.3 Industrial Mineral Potential Impacts

Both active and "prospect" industrial mineral mining operations are permitted within the project area. See Karst and Geohazards Study (Gannet Fleming October 2004) for existing or prospective operations. The existing operations are extracting limestone for aggregate production and are very large and deep open pit mines. There is also one ore mine prospect in the project area. These mines, like the coal mines, potentially have both economic and physical impact to the project.

The economic impact is that of the increased value of the land due to the developed mineral resource on the property. Additional cost would be incurred to move the mining and crushing equipment; as well as the administrative office to another location. There would also be significant cost to the operator to purchase and permit another facility.

The physical impacts include the abrupt vertical change in elevation at the edge of the pits. The cost to build embankment in the pit or a structure to span the pits would be significant. Due to the depth of the pit, groundwater infiltration and pollution potential will be extremely high.

5.2.4 Oil and Gas Potential Impacts

Both oil and natural gas fields are found in the project area [See *Karst and Geohazards Study* (October 2004) for permitted wells]. Although it is not expected that the petroleum and natural gas fields would be significantly impacted by a specific alignment, it is possible that individual wellheads could be affected. It is desirable to adjust alignments to avoid purchasing mineral rights and performing well abandonment.

5.2.5 Floodplain Impacts

Floodplain Impacts

Pursuant to Executive Order 11988 "Floodplain Management", the proposed project was determined to be within one or more of the 100 year floodplain of the following streams/rivers:

- Flat Lick Creek
- Stewart Branch
- Buck Creek
- Line Creek
- Rockcastle River
- Sinking Creek
- Little Laurel River

Table 5.2.5-1 is a summary of the impacts to floodplains on these waterways within the project area, listed by alternative. From Table 5.2.5-1, the Pulaski County alternative with the greatest amount of impacts to floodplains is Alternative KY80-Modified (58.78 acres). Sixty-three percent of its impact to floodplains is to the Flat Lick Creek floodplain with 1,622,568 ft^2 (37.25 acres) of impact. Moreover, this impact is longitudinal at two crossings. The Pulaski County alternative with the least amount of impact to floodplains is Alternative B-D (4.91 acres). Among Laurel County alternatives, Alternative H has the greatest amount of impacts (22.21 acres), primarily to the Little Laurel River (780,690 ft^2 or 17.92 acres). Alternative G has the second greatest amount of impacts, also mostly to the Little Laurel River (708,541 ft^2 or 16.27 acres). Alternative M has the least amount of impacts to floodplains among the Laurel County alternatives (4.92 acres). The Rockcastle River floodplain is impacted equally by all Laurel County alternatives (90,162 ft^2 or 2.07 acres of impacts, each).

Floodplain Avoidance, Minimization and Mitication

Any encroachment onto floodplains will require close coordination with KDOW, and the USACOE. Any development in the floodway is restricted to activities that will not interrupt the natural flow of the waterways. The proposed structures would have an effective capacity such that backwater surface elevations are not expected to rise significantly; therefore, there would be no significant impacts on natural and beneficial floodplain values, or change in flood risks.

Federal Highway Administration's floodplain encroachment policy requires longitudinal encroachments to be avoided wherever practicable. If longitudinal floodplain encroachments cannot be avoided, the degree of encroachment should be minimized to the extent practicable. Generally, any increase in the 100-year water-surface elevation produced by a longitudinal encroachment on a National Flood Insurance Program (NFIP) floodplain should not exceed the one foot allowed by the federal NFIP standards. Pulaski County Alternative KY80-Modified had longitudinal floodplain impacts and the greatest amount of impacts (58.78 acres) of the Pulaski County alternatives. Sixty-three percent of its impact to floodplains is to the Flat Lick Creek floodplain with 1,622,568 ft^2 (37.25 acres) of longitudinal impact, which occurs at two crossings.

Federal Highway Administration floodplain encroachment policy requires that all transverse encroachments be supported by analyses of design alternatives with consideration given to capital costs, risk, and other site-specific factors. "Supported" means that the design is either shown to be cost-effective or justified on some other engineering basis. The analysis process used to develop this support is referred to as a design risk assessment. This assessment is to be documented in a hydraulic design study report and retained in the design files. For transverse encroachments on NFIP floodplains, the analysis of design alternatives should include consideration of a design that is consistent with the federal NFIP standard that allows a one-foot rise in the 100-year water-surface elevation.

Impacts to Karst

5.2.6 Karst Terrain Impacts

The nature of the potential impacts due to the presence of karst terrain in the study is two fold. One is the impacts the karst terrain features may have on the project; the other is the impacts the project may have on the karst features or the environment it supports. The impacts the project may have on the karst terrain are detailed in the hydrology and karst fauna sections of the report.

Many of the karst features inventoried in the study are surface expressions of the solutioning (dissolving) of the limestone strata. The dissolution process creates void space in the strata below the surface. The presence of the void space often goes unnoticed until a collapse occurs. The potential of subsurface void space, regardless of the source, is a negative impact on a civil engineering project. Detailed geotechnical and geological investigations are required to minimize the potential impacts at the time of construction. The threat from the formation of karst features post-construction is a risk that is incurred by all projects located in karst terrain.

The potential impacts to the project from the karst terrain are:

- Future occurrence of karst features where they are not currently well-developed.
- Extreme variability in the top of rock profile over short distance can result in cost overruns for deep foundations, if required.
- Additional construction cost to mitigate collapse features encountered during construction.
- Risk of catastrophic collapse of overburden into a cave system.
- Construction cost associated with encountering high volume spring discharge and installation of conveyance systems.
- The relatively shallow soil cover in the karst plains may result in higher construction cost due to importation of embankment fill material and the higher cost of blasting bedrock to maintain practicable vertical roadway profiles.

Table 5.2.6-1, on the following page, summarizes general impacts to karst features per alignment. Only Pulaski County alternatives were considered because karst yielding geology is sparse within Laurel County. Each alternative is ranked according to the amount of impacts it has on the resource, with 1 representing the least amount of impact.

Table 5.2.5-1 Floodplain Impacts of Area Streams by Alternative

Alternative	Impacts to Floodplains per Stream by Alternative							Total Impacts per Alternative		
Pulaski County	Flat Lick Creek (ft^2)	Stewart Branch (ft^2)	Buck Creek (ft^2)	Line Creek (ft^2)	Rockcastle River (ft^2)	Sinking Creek (ft^2)	Little Laurel River (ft^2)	Total (ft^2)	Total (Acres)	Alternative Ranking
K	46,683	0	182,441	0	54,216	0	0	283,340	6.50	3
KY80 Modified	1,622,568	658,128	224,269	0	55,532	0	0	2,560,497	58.78	6
KY80 Shifted	232,698	276,450	102,418	0	55,721	0	0	667,287	15.32	5
B	114,869	0	43,713	30,326	54,790	0	0	243,698	5.59	2
D	0	0	250,453	0	55,199	0	0	305,652	7.02	4
B-D	114,869	0	43,713	0	55,199	0	0	213,781	4.91	1
Laurel County										
G	0	0	0	0	90,162	0	708,541	798,703	18.34	4
H	0	0	0	0	90,162	96,521	780,690	967,373	22.21	5
I	0	0	0	0	90,162	61,967	124,355	276,484	6.35	2
L	0	0	0	0	90,162	75,028	124,355	289,545	6.65	3
M	0	0	0	0	90,162	0	124,355	214,517	4.92	1

5.2.7 Karst Hydrogeology

Impacts to Karst Hydrogeology

The potential impacts to the groundwater in the I-66 project area include the following general potential impacts:

- potential for loss of the karst system through construction activities
- construction over caves, cave systems and other karst formations
- sedimentation of sinkholes and underground conduits, and changes in groundwater recharge patterns

Potential upstream/downstream impacts include:
- flooding potential and "valley tides"
- drainage basin fragmentation and increased sedimentation

Valley Tides

According to one local investigator flooding and "valley tide" conditions exist within the mature karst that underlies the I-66 project area in Pulaski County. Simpson (unpublished work) documents that the Sinking Valley drainage system drains 33 square miles of karst including at least 20 sinking streams and countless wet-weather sinks and that the system acts as an elaborate and complex storm drainage system, with overflow routes, underdrains, and retention tanks. Much of the conduit system is inundated and during heavy storms accepts water from sinkholes and inputs as much as 100 feet higher in elevation. This creates high pressures that force water out of sinks that accept surface drainage. Locally, water rising from sinks is called a "valley tide".

Sinking Valley Cave is a huge drainage system with hundreds of input sinkholes, some of which backflow during storms. The system feeds into a trunk conduit as much as 60 feet wide by 12 feet high, most of which is water filled. The accessible portions may be overflows for deeper conduits. Blockage of the master conduit or other tributary conduits could cause flooding, undermining of the new and old roadways and creation of new collapse sinkholes.

Impacts to Karst Hydrogeology (Continued)

Water quality impacts might include:
- changes in stream bedload or suspended load
- changes in pH/conductivity/temperature/dissolved oxygen (increase or decrease)
- changes in principal anions (Cl, HCO3, NO3, PO4, SO4) and principal cations (Na, Ca, Mg, Fe, Mn)

Chemical pollution might include:
- heavy metals (Cr, Pb, As, Hg, Zn)
- hydrocarbons (alkanes, alkenes, ketones)
- organic compounds (VOCs, pesticides, herbicides)

Contaminants can originate from a variety of land-use activities such as the following some of which are already present in the karst area of the I-66 project:

- agriculture
- mining
- construction
- septic tank leachate
- urban stormwater runoff
- spills
- industrial wastewater discharges
- illicit dumping
- landfill leachate

Ground water in karst terrain can be extremely vulnerable to contamination. This vulnerability varies according to the nature of the contaminant, karst features, occurrence of ground water in karst terrain, the degree of contact of infiltrating water with the soil zone, and the opportunity for transported pollutants to enter the aquifer system.

Contaminants of concern, such as those listed above, are generally of a chemical or biological nature with the following properties:

- Chemical contaminants can be classified as inorganic or organic, dissolved or suspended (particulate), or volatile and include many industrial organic compounds, herbicides, nutrients, and trace metals.
- Biological contaminants include viruses, bacteria, and other microorganisms and may or may not be associated with other suspended matter.
- Dissolved contaminants in conduit-flow aquifers can be readily transported under all types of flow conditions.
- Constituents associated with suspended matter (i.e., bedload and suspended load) generally require more energy (generated by high velocities and turbulence) for transport. The energy required for transport is related to the density, size, and shape of the suspended particles. Contaminants can be attached to sediment and include insecticides, nutrients, and heavy metals.

In the well-developed solutional openings in some karst aquifers, it is common for large-sized sediment and other particulate material with associated contaminants to be readily transported.

These contaminants may enter the aquifer from a sinking stream or sinkhole, move rapidly through the conduit system, and exit at a spring or well.

According to Mull et al (1988), almost all water that reaches a ground-water flow system percolates through a soil zone. The soil zone can significantly enhance the quality of percolating water by filtration, various physical and chemical reactions (solution, precipitation, oxidation-reduction, ion exchange, adsorption/desorption, and acid-base reactions), microbiological transformation, and other physical, chemical, or biological processes; however, in karst terrain, the infiltrating water may have little or no contact with the soil zone and, thus, limited opportunity for quality enhancement before entering the groundwater system. Ray et al. (1994) developed a rating system for groundwater pollution sensitivity for Kentucky and rated the Mississippian Plateau region which includes the I-66 project area as extremely sensitive.
(Karst Hydrogeology Impacts Continued on Next Page)

Table 5.2.6-1 Number Karst Features Directly Impacted per Alternative

	K	KY80-Shifted	KY80-Modified	B	D	B-D
Feature Type	**Impacts**					
Closed Depression	43	33	60	14	20	14
Complex Sink	22	17	29	7	14	7
Cave	1	1	2	1	1	1
Disappearing Stream	1	0	0	1	3	1
Epikarst	9	3	7	4	8	4
Grike	1	3	3	0	0	0
Karst Window	2	1	1	0	1	0
Resurgence	1	1	1	0	0	0
Sinkhole	107	93	121	38	59	38
Spring	22	27	34	14	29	14
Sunken Valley	0	0	1	0	0	0
Swallet	2	2	3	1	2	1
Total Number of Features Impacted	211	181	262	80	137	80
Rank	4	3	5	1	2	1

Donaldson (2004), reports that "although there is an abundance of literature concerning karst groundwater quality, relatively little research has been conducted addressing the specific impacts of highway runoff to groundwater in karst areas." She further states that "Most aquifers have been impacted by more than one land use activity. Assessing the impacts of highway runoff on groundwater quality is complicated by these other contaminant sources. Despite the frequent grouping of highway runoff and numerous pollution sources as targets for control by regulatory agencies, research indicates that agriculture and industry are the most significant sources of groundwater pollution in karst areas. Livestock and crop production, in particular, are often singled out as significant contributors to groundwater protection in karst aquifers."

Donaldson (2004) also reports that numerous studies have investigated the constituents of highway runoff and the factors affecting its quality and quantity. The results of these studies vary greatly depending on a number of factors. These include traffic volume, surrounding land use, rainfall intensity and duration, length of dry period, operation and maintenance characteristics, degree of imperviousness of the drainage area, and ground slope. The first flush effect, whereby concentrations of pollutants decrease with time during runoff events, also factors into the determination of runoff quality.

Two significant conclusions drawn by Donaldson (2004) are the following:

- The literature suggests that highways are not major contributors of non-point source pollution of karst aquifers compared to other land uses.
- Highway construction can have adverse effects on groundwater quality and aquatic organisms, particularly in karst areas when BMPs are not properly employed.

Donaldson (2004) makes the following notable comments regarding BMPs for highway construction:

- Highway construction, particularly instances when BMPs are improperly employed, can have a more evident and devastating effect on aquatic animals. Improper highway construction practices created repeated episodes of muddy water in karst springs, which caused a large trout die-off due to clogged fish gills.
- Sedimentation and filtration process are valuable practices for removing the majority of the metals that pose the highest environmental concern in terms of groundwater pollution. Wet detention ponds are among the most common BMPs for the control of stormwater runoff and can be very effective in controlling a wide range of pollutants. Heavy metals in highway runoff concentrate in the bottom sediments of ponds, which have a great capacity to retain heavy metals.
- Another stormwater detention method, though not widely practiced, involves the diversion of highway runoff into wetlands. With this method, runoff constituent concentrations have been found to decrease greatly from the wetlands inlet to the outlet.
- Without strict adherence to BMPs, highway construction has been shown to have a pronounced effect on water bodies. Highway construction can particularly affect the erosional processes in a watershed. The extent of the impact depends on factors such as climate, soil characteristics, vegetation, geomorphology, and construction methods.

A very complete review of non-point pollution related to highways; "Evaluation of Methods to Protect Water Quality In Karst Areas: Phase I", was published by the Kentucky Transportation Center, College of Engineering, UK, in cooperation with the KYTC (Webster et al. 2003), Research Report KTC-03-30/SPR237-01-1F). This project provided a thorough examination of water quality issues related to highways and discusses the problems and issues related to karst terrains. Some of the significant general findings reported by this study include:

- "Recent studies have suggested that highway runoff from interstate roadways may be a significant contributing factor in the pollution of karst aquifers. In particular highway runoff may contain high concentrations of heavy metals, which are toxic to aquatic life, and often accumulate due to the fact that they do not readily degrade in the environment. Other pollutants such as oil, gasoline, and suspended solids are also of concern and may threaten aquatic habitats and those potential health hazards to the public."
- "Managing protecting groundwater sources within karst areas is not simple. In order to determine which best management practices are most applicable to a particular highway site, background studies that characterize the highway design features, operating conditions, maintenance practices, and drainage system are all needed."

Of particular significance with regard to water quality impacts in the I-66 project karst areas are the following conclusions drawn by Webster et al (2003):

- Although many studies have addressed the impacts of storm water and highway runoff on surface water, relatively little attention has been directed towards assessing its impacts on groundwater, especially in karst areas.
- Despite the ability of karst groundwater to move rapidly through conduits and fractures, contaminants introduced into karst aquifers may persist for long periods of time because fractures, bedding plane partings, and less integrated bedrock pores tend to function as storage reservoirs during periods of high flow.
- Physical properties of the contaminant may also affect contaminant transport. Light non-aqueous phase liquids (LNAPLS) move more efficiently in conduits which are not totally flooded, while migration of heavier solids may be limited or stopped when a conduit becomes completely flooded.
- High intensity storm events can wash pollutants from roadway surface and re-suspend the materials deposited deep within the underground caverns.
- Natural background groundwater quality characteristics in karst aquifers are often difficult to discern because of the impact of one or more land use activities and because spatial and temporal water quality variations can be extreme in karst systems.
- A wide range of permeability, groundwater velocity and groundwater residence time is common in karst aquifers.
- The FHWA reports that studies have suggested that highways are not major contributors of non-point source pollution in karst aquifers compared to other land uses.

Findings of Ongoing Dye Tracing Studies

As discussed in Section 4.2.5 the groundwater tracing study by the University of Kentucky, Kentucky Geological Survey will continue through early 2006. A drought in the fall and winter of 2005 delayed completion of the dye tracing efforts. The areas in the field that need further tracing are on either side of Buck Creek, mostly to confirm or expand on work by students of Dr. Ewers, south of existing Kentucky 80 and on Line Fork.

Groundwater Trace Results

'The KGS has completed 43 groundwater traces in the hydrologic project area. Fourteen traces have been attempted east of Buck Creek, of which ten have been recovered. The following descriptions of the groundwater tracing results are given by hydrologic basin. ***All of the following referenced basins and dye tracing vectors (flow paths with arrows) are shown in Figure 5.2.7-1 in Appendix C.*** Flat Lick Creek Basin includes a number of groundwater sub-basins that are individually significant and are shown on the basin maps.

Basin A: Vaught Spring forms the headwaters of Vaught Branch and is located on the extreme western end of the hydrologic project area. The trace crossed into the project area and was detected at Vaught spring. The estimated groundwater basin boundary extends north beyond Coleman Rd. This trace reveals the existence of a significant conduit system and if the Kentucky 80 corridor is projected west, the corridor will cross this suspected cave.

Basin B-1: (East of Vaught Spring) Tracing reveals the groundwater basin headwaters near Buzzard Knob. The surface drainage is effectively a losing stream that temporarily resurges at Mckenzie Creek spring. The stream sinks a second time to reemerge at McKenzie Underflow spring, located a few hundred feet upstream of the bridge on McKenzie Road. This trace is significant because it brackets and defines the northern limit of the Garner Old Barn spring basin (B-2).

Basin B-2: Garner Old Barn groundwater basin includes the Coleman Road karst valley. The Coleman Road karst valley is used by the sewage treatment plant for land spreading disposal for its sludge, and the quality of the groundwater in the basin could be negatively affected, as there is evidence of debris in the short segment of cave a few feet from the swallow hole. Two traces were conducted from the valley and one from the Saltpeter Knob to the north that were all

recovered at Gardner's Old Barn Springs (see three traces in Gardner's Old Barn basin in Figure 5.2.7-1 in Appendix C). The resurgence at the Gardner Springs is a wide distributary that forms the head of the northern most branch of Big Spring Branch.

Immediately west of the junction of Coleman Road and KY 317 is a karst valley that has floodplain morphology. The DeBord karst valley has a widely spaced complex of small swallow holes on the east end and both underflow land high-flow springs on the west, as well as receiving overland flow from the west. This feature is about 1,000 feet south of the Kentucky 80 modified alternate. Although KGS has not observed flooding at the karst valley, and the valley did not flood as a result of the 3-inches of precipitation on January 23, 2006, there remains the potential for flooding events. An increase in the volume or rapidity of runoff from the removal of vegetation or the addition of impervious surfaces will contribute to any existing tendency to flood. Infilling of the karst valley may block swallow holes, resulting in compromised roadway stability caused by water saturation of the fill material. Further, the trace from Saltpeter Knob (Topmost trace in Old Barn Spring Basin shown in Figure 5.2.7-1 in Appendix C) suggests the KY 80 alternatives may intersect a water-carrying conduit, depending on the depth of any road cut and the finished elevation of the grade relative to the conduit. Alternatives crossing adjacent to, or across either the DeBord or Coleman Road karst valleys will need appropriately designed drainage control.

Basin B-3: Approximately a half mile north of the junction with Kentucky 80 on Kentucky 461, short trace from a swallow hole on the shoulder of 461 flowed to a spring also along 461. Culvert Spring a sub-basin of Flat Lick Creek, has been channeled into a culvert and underlies the roadway. Based on estimated discharge, it is proposed that this basin is small; however the spring is at the northeast end of the KY 80 alternatives exchange with Kentucky 461. Reconstruction of the bridge over Flat Lick Creek may encounter poor foundation stability conditions if the spring is overprinted.

Basin C: Meander Spring karst groundwater basin sets a northeastern limit on the Flat Lick Creek watershed. A trace from the Carter farm injected into a sinking stream was detected at a failsafe bug deployed on Rainey Road where it crosses over a stream draining an abandoned meander of Buck Creek. The basin has no direct relevance to the planned alternatives but is noted as an example of a groundwater basin extremely vulnerable to contamination from hazardous materials on Kentucky 461 and potentially the Toyotetsu American Inc. factory.

Basin B-4: The Old Shopville Road spring basin is south of the Meander spring groundwater basin (Basin C) and the eastern most catchment area of Flat Lick Creek. A trace injected into a cave stream near the electrical substation at Dahl was recovered at the spring. More importantly, the trace from the Dahl substation defined the western limit of another newly discovered and significant groundwater basin on the eastern side. Roadway design will need to accommodate the discharge from this spring.

Basin D: Elwood spring is located on the north bank of Buck Creek about one-half mile downstream of the Stab Bridge, and was named by KGS for Elwood Taylor, former owner of this spring and Short Creek. Two traces have been recovered at Elwood spring. One was injected into a swallow hole in the valley between Tom Knob on the northwest, Timmy Knob on the south, and south of Jenkins knob on the northeast. The crest of the three hills is thought to form the topographic watershed and groundwater basin boundary. The second trace was injected into a spring fed swallow hole on the shoulder of Kentucky Highway 80 at the northeast base of Timmy Knob. The basin extends from Buck Creek to north of Shopville at Fellowship Knob. The inferred groundwater-flow route crosses the topographic divide between Flat Lick Creek and Buck Creek, a major divergence of the groundwater basin from the topographic watershed of Flat Lick Creek.

A segment of Kentucky Highway 80 passes between Timmy Knob and the southern end of Jenkins Knob, and through the interior of the Elwood spring basin. The roadway lies directly over and nearly parallel to the groundwater trace vectors to Elwood spring for over 3,000 feet. All but one of the drawn proposed routes follows existing Kentucky 80 along this same half-mile segment of road. Because of the parallelism of the roadways with the main stem conduit, the groundwater flow system is exposed to a large aggregate of truck transportation miles per year. Elwood spring is therefore vulnerable to spills from vehicular accidents, as compared to the road being crossed perpendicular to the inferred groundwater flow routes.

Basin E: Sinking Valley (Short Creek) has been extensively studied by students of Dr. Ralph Ewers at Eastern Kentucky University. The majority of their work was interior to the groundwater basin however. The traces completed for this study on the east side of Buck Creek have been attempts to place outward boundaries on the extent of the previously mapped groundwater basin. The traces for this study define Lighthole spring (Basin K) and the Osborne spring (Basin L). They also clarify the extent of the Burdie Valley and Price Valley tributaries. The groundwater basin boundary of Sinking Valley (Basin E) was previously drawn to include Burdine Valley (Currens and Ray, 1998). A groundwater trace was injected near the headwaters of Burdine Valley in a sinking stream, named Waterfall Swallet, and was detected at Short Creek. This demonstrates the existence of a conduit, of unknown size and depth, tributary to Short Creek underlying Burdine Valley and confirms the current delineation of the boundary. Alternative D crosses the valley approximately 1,500 feet upgradient of the confluence with the conduit from Sinking Valley. Flooding of surface channel will not be a concern because there is no evidence at this time the Burdine Valley watershed is larger than indicated by topography, or that the cave draining it is undersized for the watershed. Groundwater water contamination of Short Creek is however a risk from highway runoff along Brushy Ridge. The runoff would sink as it reaches the carbonate outcrop and enter the groundwater.

Previous traces have shown that the sinking stream flowing through Price Valley Cave emerges at Short Creek. KGS conducted additional tracing in the upper parts of Price Valley to determine the importance of the cave stream at Blackhawk Cave, which sinks down stream of the cave entrance and eventually through Price Valley Cave. Two traces were injected into upper Price Valley at the top of the Newman Limestone and another into Bolger Hollow at the contact. All three of the traces emerged in the stream in Blackhawk Cave, indicating that the cave drains all of Price Valley. A significant number of traces are still needed to refine the position of the boundary of Sinking Valley groundwater basin.

Basin F: To the south of Burdine Valley is Dark Hollow, which discharges to Buck Creek. The lower reaches of Buck Creek are only accessible by boat, and the receptor deployed in the spring at the mouth of Dark Hollow (basin F) is perhaps the most remote among those in the project area. One trace was injected at a swallow hole about 3,000 feet up valley from the spring. Because of the remote location, the first receptor was deployed for an extended time (weeks). The tracer was detected, however, at a significant concentration in the first receptor and at a low concentration in the replacement receptor. No further traces were conducted because no additional injection points were found that are likely to have results significantly different from the first trace. The groundwater basin is probably coincident with the topographic watershed.

Basin G: On the west side of Buck Creek and south of KY 80 are several groundwater basins delineated by Dr. Ewers, students. Cedar Creek, which was traced by Morris (1972) to springs along the west bank of Buck Creek bounds the Flat Lick Creek karst groundwater basin on the south. Morris reported one trace, D3, as lost. D3 was injected into a vertical shaft on the south side of Brushy Point, the topographic divide separating Cedar Creek from Flat Lick Creek drainage. Alternative D traverses this dye injection point (Gannett Fleming Field ID NO. BDCV2901). It is possible the D3 trace flowed to the Flat Lick Resurgence, which was not monitored at the time, or was diluted and simply not detected at Cedar Creek springs. Although the easily viewed dimensions of the vertical shaft are known, it and similar features that are developed along the base of the Paragon (Pennington) Formation that have not been unroofed are a geologic hazard to construction. The Cedar Creek basin appears to pose risk for alternative D. The southern limit of Cedar Creek is limited by a single trace to Bridge Hollow spring

Basin B-5: The Phelps spring (basin B-5) is important because it confluent within a few feet with the spring run from Hargis groundwater basin (basin B-8). It also borders the Flat Lick Creek watershed on the south. The combined flow from the Hargis basin and Phelps spring are a significant fraction of flow in Stewart Branch.

Basin I: The ridge crest south of Phelps basin and partly surrounding Blaze Valley is the northern topographic watershed boundary of the Loveless spring

groundwater basin (Basin I). Two traces were injected near the watershed boundary and both were detected in Loveless spring on Piney Grove Road. The groundwater basin of Loveless spring was further constrained by one trace in Peter Cave Hollow (basin H) on the southeast. Loveless spring is a domestic water supply.

Basin J: The Placke spring basin abuts with the headwater boundary of Phelps spring sub-basin and the untraced Rocklick Cemetery spring basin. One trace injected north of Grundy Junction, was recovered at the Placke overflow and underflow springs. This underflow spring is a domestic water supply.

Basin B-6: Skipping a valley to the northwest, we have delineated the groundwater basin draining to the locally well known Big spring. Two swallow holes on the shoulder of Kentucky 80 have been traced to the spring. One hole receives runoff directly from the right-of-way and the other from both the right-of-way and from a truck parking area. Persistent, background levels of fluorescence at the wave length of fluorescein are consistently recovered from the receptors. This prevented the use of fluorescein for any traces that might go to Big spring. All of the traces were completed with other dyes. One possible source of the background fluorescein is anti-freeze leaking from trucks at the nearby truck park.

The Big spring groundwater basin extends westward of the old log building across Kentucky 80 from the BP station. The basin to the north of Highway 80 has been expanded into the New Haven Lane area because the discharge for the spring (estimated at 0.5 ft.3/sec, summer low flow 0.15 ft.3/sec) suggests a much larger watershed than indicated by the topography. Groundwater traces at the head of Soul Chapel Branch flowing to the southwest limit extension of the basin further westward. From estimates of the watershed of Big spring, Kentucky 80 may pass over a cave with significant dimensions in that vicinity. It appears that a sinkhole a few hundred feet west of the junction with James Road, and upgradient of the spring, was filled during construction of the highway. There is no documentation of how the fill was placed but if it was not structured for stability, cover collapse problems are possible in the roadway at that location. There is a low probability of bedrock collapse.

Basin B-8: The Hargis spring (Gannett Fleming Field ID No. BBSP2402) groundwater basin (B-8) includes the Bates and Toby springs sub-basins and is one of the larger and most complex basins in the western half of the project area. Sink points on the Toby farm contribute flow to Bates spring. Water sinks at Toby sinking stream and swallet during high flow to discharge at Toby overflow spring, then overland to Stewart's Branch. A groundwater trace from the northwest (Fig. 6) passed through Lawson Karst Window (Gannett Fleming Field ID No. BBKW2401) to discharge at Hargis. Lawson Karst window is less than 30 feet deep, which indicates the active conduits are at shallow depth under the Lawson farm and are aligned along the valley bottom. The Toby overflow spring also suggests depth to conduits is shallow due west of Bates spring. Higher elevation, segmented, and abandoned caves are likely to exist in the carbonate sequence of the knobs adjacent to the Lawson-Toby-Bates karst valleys. The Lawson karst valleys followed by both Alternatives B and D could incur additional cost from managing the drainage and continued risk from cover collapse by underlying conduits.

Basin B-7: The Shopville Park spring groundwater basin (B-7) is perched on the Salem-Warsaw Formation. It drains a comparatively small area. The existing Kentucky 80 passes the drainage boundary on the north and the current route probably does not pass over any large conduits. The proposed Kentucky 80 alternatives may encounter the main stem of the conduit system if a cut were to intersect the conduit. Peak flows are estimated at 2 to 5 cubic feet per second and therefore grade stability over the long term will be addressed.

Basin B: The Flat Lick Creek watershed has several interior groundwater sub-basins, some of which are of significant size, including Big spring, Garner Old Barn, Culvert, and Phelps springs (previously discussed). The other sub-basins delineated so far are Shopville Park spring, Old Shopville Road spring, and the significant Hargis spring basin. The main stem of Flat Lick Creek flows on the top of the Borden Formations (Salem-Warsaw equivalent) and would not be expected to be loosing flow. Because the gradient of the stream is not as steep as the apparent dip, the channel moves up the stratigraphic section down stream. It becomes bedded on St. Louis limestone as the one nears Buck Creek. Karst development in the Flat Lick watershed, therefore, occurs mainly in the headwaters of the watershed and near the confluence of Flat Lick with Buck Creek. The existing Kentucky 80 route crosses Flat Lick Creek at an elevation sufficient to avoid back flooding (greater than 860 feet). The Owl Cliff swallow hole and a reach approximately 5,000 feet upstream form the feature may be inundated for longer than periods of time than an event in a normal drainage basin.

Finally, at the extreme eastern end of the hydrologic project area is Line Creek. KGS has only done scouting in this basin because it is remote and is probably hydrologically isolated from the other karst groundwater basins. Recent scouting has resulted in the location of a major spring and suggests there is a significant conduit below and offset to the surface channel. Continuing work in Line Creek valley will focus on determining if the groundwater basin is coincident with the topographic watershed.

Alternatives Consideration in Relation to Groundwater Basins

Present research indicates that, from a groundwater basin perspective, the design locations of the Kentucky 80 alternatives west of Buck Creek, and that of alternate D east of Buck Creek are preferable. They minimize risk of flooding or cover collapse. The segment (west of Buck Creek) of the Kentucky 80 alternatives crosses groundwater basins that may have degraded water-quality and the segment of alternate D (east of Buck Creek) is on top of Brushy Ridge and largely off of the carbonate rocks. Vertical shafts will be closely spaced along the Paragon (Pennington)-Newman Limestone contact on either side of Buck Creek and could be frequently unroofed by road cuts that are graded along this contact. From the perspective of karst hydrogeology and geohazards, construction of a build alternative would likely cause some damage to the aquifer as a water supply or habitat for wildlife. KGS has considered the proposed build alternatives and finds that portions of the above referenced two alternatives avoid some of the more critical groundwater basins.

The overall environmental impact of construction and operation of I-66 will hinge on which groundwater basins it traverses. Some groundwater basins may already be impacted by Kentucky 80 and other contaminant sources. These include the Garner Old Barn groundwater basin, Big spring basin, and Elwood spring basin.

Flooding in the Flat Lick Creek valley where crossed by alternative B is less likely than previously thought because of the capture of part of the watershed by Elwood spring. Other areas where the intersection or blockage of conduits can result in flooding hazards include the DeBord karst valley (Basin B-2), alternative D at Grundy Road (Basin B-8), and the Kentucky 80 alternatives at Shopville Park area. Further discharge measurements await a major storm event.

The most critical location of potential collapse is in the valley northeast of Timmy Knob, between Buck Creek and Shopville, in the Elwood spring groundwater basin. Most of the corridors, and existing Kentucky 80, are routed through the valley northeast of Timmy Knob. Other areas where concentrated recharge into conduits could result in stability failures include the Lawson karst valley, the Hargis groundwater basin and the Garner Old Barn basin (Coleman Road). A section of Price Valley (Blackhawk Karst Window) is a potential bedrock collapse if the excavated grade is too deep. Vertical shafts will be frequently unroofed along the Paragon (Pennington)-Newman Limestone contact, particularly by alternative D.

Based on available data concerning karst geohazards, KGS recommends that consideration be given the Kentucky 80 alternatives (west of Buck Creek) coupled with alternate D (east of Buck Creek). These locations have comparatively less project-wide impact on the karst aquifers because they avoid Sinking Valley and are routed along groundwater basins thought to be impacted by existing land uses. The sensitivity and geologic hazards described in Elwood spring basin, though not dismisses as unimportant, are somewhat offset by the protection of larger basins assumed to be just as sensitive and nearly pristine.

5.2.8 Potential Diminution of Water Supplies

Because changes in recharge areas, groundwater flow paths, and drainage basin fragmentation may accompany highway construction within karst areas within the Pulaski County segment of the I-66 project corridor, it is possible that changes may occur in local water supply systems. It is anticipated that a number of water supplies within the project area may currently provide water that does not meet drinking water criteria.

5.2.9 Changes in Recharge Areas/Flow paths/Drainage Basin Fragmentation

Blasting and excavation associated with construction may trigger sinkhole collapse and sediment movement that can alter local drainage patterns resulting in changes to the recharge areas of water supplies, changes in groundwater flow paths and/or drainage basin fragmentation. Sealing drainage conduits or other karst features may block natural discharge of groundwater or surface water leading to changes in flow paths which might result in flooding or activation of other drainage features. Contractors will be made aware of sensitive features through the use of notes on the design plans.

Karst Mitigation

5.2.10 Mitigation of Karst Impacts

Kentucky Transportation Cabinet Best Management Practices (BMPs) will be followed during the construction phase of the project. In karst related instances in which written procedures are not in place, the KYTC will develop new measures and will communicate these to the contractors. Prior to acceptance of the final design plans, a review will be developed which will set out these appropriate and practicable measures of offset unavoidable impacts to karst features.

Groundwater protection measures will be addressed during design and implemented during construction for that portion of the project in Kentucky. Best Management Practices, FHWA guidelines, the Kentucky Department of Highways Standard Specifications, and the KYTC Generic Groundwater Protection Plan will be followed.

Construction methods for karst features focus on overcoming the voids and weaknesses of the soil and underlying rock caused by dissolution of the limestone. The selection of the construction method considers the karst feature type, its dimensions and depth, as well as the highway component to be protected. Future potential for additional impacts to develop also has to be considered. Potential construction methods for this project include geosynthetic reinforced soil, concrete cap, reinforced bridging and deep foundations.

Geosynthetic Reinforced Soil
A geogrid or geotextile reinforced soil mat is constructed to bridge over the karst feature and the highway embankment or pavement is completed using conventional construction means.

Concrete Cap
The karst feature is excavated to expose the rock surface and a concrete slab is placed to seal the rock. The excavation is filled with compacted backfill and construction is completed using conventional means.

Reinforced Bridging Slab ('Land-Bridge')
The karst feature is filled with compacted backfill or grout and a reinforced concrete slab is constructed to bridge over the feature. Construction is completed using conventional means.

Deep Foundations
When overburden soils are thick, the filled karst feature is not sufficiently strong, or the upper surface of the rock cannot support required loadings, the highway structure is founded on either piles or caissons bearing on competent rock below the bottom of the karst feature.

5.2.11 Mitigation of Karst Hydrogeology

The following text is a summary of the means by which potential impacts to the karst aquifer system which underlies large portions of the Pulaski County segments of the I-66 project may be avoided, minimized, or mitigated. It is recognized that it is advisable to avoid impacts where possible; however, if avoidance is not possible, alternatives that minimize impacts are recommended. In the event that neither avoidance nor minimization is possible, mitigation strategies are required.

5.2.12 Mitigating for Increased Flooding

Increased flooding resulting from the alteration of natural karst drainage ways is considered to be an avoidable potential impact of highway development within the karst areas of the I-66 project area within Pulaski County. Despite substantial potential alterations in the local drainage patterns a number of steps can be taken to avoid changes to the drainage conditions that prevail presently within the project area. Avoiding this potential impact may be accomplished by the following:

- Minimize impervious cover materials.
- Minimize altering natural drainage conduits by managing blasting and erosion and sedimentation measures.
- Avoid disturbance of “trunk” drainage ways.
- Design project drainage components with the recognition of “valley tide” potential.

5.2.13 Mitigation for Changes in Recharge Areas/Flow Paths/Drainage Basin Fragmentation

Significant changes to the aquifer recharge areas are not anticipated as the result of the I-66 project, however changes may be anticipated to groundwater flow paths. Blasting and excavation associated with construction may trigger sinkhole collapse and sediment movement that can alter local drainage patterns resulting in changes to the recharge areas of water supplies, changes in groundwater flow paths and/or drainage basin fragmentation.

Such impact may not be avoidable and can utilize minimization procedures such as the following:

- Water supply assessment/replacement
- Attempt to obtain advance knowledge of the location of sinkholes, caves, underground streams, and other related karst features and their relationship prior to determining the potential impacts of the proposed rehabilitations or construction
- Erosion and sedimentation management
- Proper construction procedures
- Use of Best Management Practices
- Assessment/minimization of the drainage basin changes

5.2.14 Mitigation for Changes in Water Quality

Given that highways themselves are not considered as significant as land use in karst areas in terms of non-point pollution, most impacts to groundwater quality associated with their construction are considered avoidable or manageable and are achieved by controlling drainage such that the acute and chronic criteria for surface water quality criteria are not exceeded. Avoidance and management techniques include a variety of BMPs, which are described in Webster et al. (2003), who state that: “combination of one or more practices is necessary to minimize the impacts of development on groundwater quality. Non-structural BMPs (erosion control) are typically source control systems designed to minimize the accumulation of pollutants, and reduce their initial concentrations in storm water runoff. Structural BMPs (sediment control) on the other hand, operate by trapping and detaining runoff water until unwanted pollutants constituents settle out or are filtered through the underlying soil.”

Non-structural practices may include fertilizer application controls, vegetated buffer areas, and land use planning, and are often used in conjunction with structural controls. Reduction of pollutants often can be accomplished by the elimination of curbs or other barriers, traffic flow regulation and minimizing the use of fertilizers and pesticides.

Non-structural controls including such measures as vegetative controls, grassed swales or vegetated buffer strips are popular because of their low costs and minimal maintenance requirements. These are often used in conjunction with structural controls which typically operate by trapping and detaining runoff until unwanted pollutants constituents settle out or are filtered through the underlying soil such as the following:

- Detention basins such as dry detention, extended-dry detention, and wet ponds
- Constructed wetlands
- Infiltration trenches and basins

Publications regarding BMP’s for construction practices and related clean water issues are available from the KDOW, entitled “Kentucky Best Management

Practices for Construction Activities,"[1], "Kentucky Erosion Prevention and Sediment Control Field Guide," and "Effluent Guidelines for Construction and Development"[2].

Mitigation for Diminution of Public/Private Water Supplies

Highway construction has the potential to diminish both the quality and quantity of water available for public and private water supplies. Water quality issues and maintenance techniques have been discussed in previous sections of this report so this section will deal with water quantity diminution avoidance, minimization and management. Techniques to avoid, minimize, and manage construction related impacts to water supplies in the project area are primarily focused on small private water supplies (wells and springs) because they are most prevalent. Few public supply wells are known in the area except in Somerset. These techniques include:

- Early identification and condition assessment of water supplies in advance of construction
- Avoid Source Water Protection areas of Public Water Supplies
- Advance planning of construction techniques such as excavating or blasting
- No spray signage in karst sensitive areas designated by the KYTC Division of Environmental Analysis (DEA)

5.2.15 Mitigation for Changes in Sedimentation Patterns, Suspended Load and Bed Load

Due to the complex surface and subsurface drainage patterns associated with karst environments, which prevail in the I-66 project area, both short-term construction and longer-term changes in local sedimentation patterns may be expected. To avoid, manage or minimize these potential impacts it will be important to consider the following:

- Attempt to obtain advance knowledge of the location of sinkholes, caves, underground streams, and other related karst features and their relationship prior to determining the potential impacts of the proposed rehabilitations or construction.
- Manage construction activities to minimize soil releases to ground water via nearby sink holes. Excess silt introduced into a sink hole may seal a fissure system effectively removing means of draining the roadway. In addition to the potential deleterious effects of changes in sedimentation processes a wide range of toxic contaminants adhere to soils and may be liberated when soils are introduced into water.
- Develop project and area specific erosion and sedimentation plans for timely implementation.
- Consider that construction projects typically require the construction of detention
- and/or retention basins. Regular inspections should be scheduled to ensure minimum and satisfactory performance of these measures.
- Consider alternative methods of silt control.

5.2.16 Karst Fauna Identified In Project Area

The results of visits to 63 sites are listed in this report, primarily caves, as well as springs and swallets. A total of 114 taxa were found during sampling in caves of the project area. This was a taxonomically diverse assemblage divided among 4 phyla, 11 classes, 27 orders, 55 families and 90 genera. At 37 localities obligate subterranean animals were sampled. Of the 114 taxa listed herein, 34 were judged to be ecologically classified as obligate subterranean organisms (troglobites/stygobites), and 37 were assigned global ranks of significant rarity: G1 – 13 species, G2 – 11 species, G3 – 13 species.

Of the 34 obligate subterranean species, 28 were found in caves associated with the Sinking Valley Cave System.

The subterranean headwaters of the recharge area of the Sinking Valley Cave System lie several miles north of the project area. The main trunk of this cave system crosses into the project area east of the Shopville/Stab area and runs under the northern and Kentucky 80 bands in a north/south orientation, then turns to the west where the water surfaces at Short Creek, which immediately flows into Buck Creek.

The 28 species associated with the Sinking Valley Cave System are:

Sphalloplana percoeca – cave flatworm (G3)
Helicodiscus punctatellus - terrestrial cave snail (G1)
Carychium stygium - Stygian carych (G2)
Pseudocandona jeanneli – Jeannel's groundwater ostracod (G2)
Pseudocandona undescribed species SB groundwater ostracod
Rheocyclops undescribed species – Sinking Valley groundwater copepod (G1)
Caecidotea stygia - Northern cave isopod (G5)
Miktoniscus barri - Barr's terrestrial isopod (G3)
Crangonyx castellanum - cave amphipod (G2)
Crangonyx specus – cave amphipod (G1)
Orconectes australis – Southern cave crayfish (G3)
Pseudotremia undescribed species – Sinking Valley cave milliped (G1)
Scoterpes copei –Cope's cave milliped (G3)
Chaetaspis fragilis – Fragile cave milliped (G1)
Phanetta subterraina – Subterranean sheet-web spider (G5)
Porrhomma cavernicola – Cavernicolus sheet-web spider (G3)
Hesperochernes mirabilis - Eastern cave pseudoscorpion (G3)
Sinella krekeleri – Krekeler's cave springtail (G2)
Sinella hoffmani – Hoffman's cave springtail (G3)
Sinella barri - Barr's cave springtail (G3)
Pseudosinella christianseni – Christiansen's cave springtail (G2)
Pseudosinella hirsuta – Hirsute cave springtail (G2)
Litocampa undescribed species – Cave dipluran (G1)
Darlingtonea kentuckensis – Darlington cave beetle (G3)
Nelsonites jonesi – Jone's cave beetle (G2)
Ameroduvalius jeanneli rockcastlei - Rockcastle cave beetle (G3)
Pseudanophthalmus undescribed species – undescribed cave ground beetle (G1)
Spelobia tenebrarum – Cave dung fly (G5)

Buck Creek is apparently a local zoological (similar to geographic) divide with evidence that some elements of the fauna are different on the east and west sides of the stream. Different species of the milliped, *Pseudotremia* occur in the caves on the opposite sides of the creek, and the pseudoscorpion, Kleptochthonius, undescribed species, and pselaphid beetle, Batrisodes (Batriasymmodes), undescribed species, were found only in caves on the west side. Although no large system like the Sinking Valley Cave System is found in the project area on the west side of Buck Creek, four biologically significant caves were found there (with number of troglobites/stygobites): (1) Blowing Cave–9, (2) Cedar Creek Cave System–13 (Cedar Creek Cave and Cedar Creek Spring Cave, (3) Stykes Cave–15 and (4) Odell's Pit—14. Of these, the Cedar Creek Cave System is of note since it lies adjacent to a possible interchange.

Any site with a globally rare species (G1, G2 or G3) is of particular significance. Of the 63 sites visited, 29 of them produced one or more globally rare species. The most significant sites are ranked in table 5.2.16-1.

Table 5.2.16-1 – Summary of Significant Karst Fauna Sites within the I-66 Project Area

Caves	Composite Rarity	Obligate Subterranean Species	Alternate Association (impact to within 500 ft of opening)[1]
Stab Cave	91	19	K, KY80 Mod, B, B-D
Stykes Cave	79	15	None: D is closest
Odell's Pit	79	14	None: B is closest
Cedar Creek Cave	57	12	D
Cedar Creek Spring Cave	43	10	None: D is closest
Cave #16	42	11	D
Blackhawk Cave	37	11	K, KY80 Mod, KY 80 Shift, B, BD
Blowing Cave	36	9	None: B, B-D, & D are closest
Price Cave	33	8	K, KY80 Mod, KY 80 Shift
Osborn Cave	26	8	B, B-D
Ranch Cave	26	8	None: B & B-D are closest
Sheep Cave South	20	3	None: B, B-D & K are closest
Cave #20	18	7	None: B & B-D are closest
Burdine School #2 Cave	10	3	K, KY 80 Mod, KY 80 Shift
Cave #19	10	2	K, KY 80 Mod, KY 80 Shift
Cave #12	5	5	None: B, B-D & D are closest
Cave #2	3	3	Between KY 80 & Southern

1 Foraging distance of cave dwelling species dependant on food importation

[1] http://www.water.ky.gov/dw/profi/tips/bmp.htm
[2] http://www.water.ky.gov/sw/nps/Publications.htm

5.2.17 Impacts to Karst Fauna from Construction Activities

Construction Related Karst Faunal Disturbances

Caves contain ecosystems with terrestrial and aquatic components that are stratified in relationship to their proximity to entrances. Cave communities consist of animals that are highly adapted to the relatively buffered conditions and many species are intolerant of even small changes in temperature, humidity or other environmental parameters. The literature of cave biology is replete with descriptions of the habitat restrictions of cavernicoles and the reader is referred to one of the many references cited within the body of this report (e.g., Barr and Kuehne 1971, Kurta and Kennedy 2002). Many authors have also discussed various aspects of the vulnerability of caves and their ecosystems to disturbances associated with road construction (Keith 1988, Tercafs 2001). A few examples of the short-term disturbances associated with the construction of roads and the long-term consequences of road alignments:

Excavation

Excavation potentially damages or destroys protective overburden, subterranean faunas associated with the epikarst, or the cave passages, themselves. Studies have shown that compartments within soil and rock comprising the overburden above or adjacent to caves is inhabited by a unique assemblage of terrestrial invertebrates (Juberthie et al. 1980). The epikarst is similarly inhabited by stygobitic organisms that live in the interstitial spaces in the ground (Lewis and Bowman 1981). The modification of cave entrances and sinkholes (that may lead into caves via passages too small for humans), particularly the creation of new entrances, may change water and air flow with drastic negative effects (e.g., on temperature, humidity or nutrient input).

Fill

Fill used to decrease grades increases the load on cave roofs that in the project area have previously been demonstrated to be subject to collapse (i.e., the collapse of Quarry Sink into the Price Cave section of the Sinking Valley Cave System). Similar to the negative effects created by excavation, the damage created by fill materials can range from partial obstruction of conduits, thereby changing temperature, humidity, water or nutrient input, to sealing the conduits completely with adverse results to the cave community.

Cave animals in the Pulaski County area are completely dependent upon the importation of food into the subterranean environment by inflowing water or the movements of trogloxenes (e.g., cave crickets, bats, woodrats or raccoons bringing in their droppings, nest materials and carcasses). The obstruction of entrances or even seemingly insignificant crevices in bedrock or sinkholes can stop the flow of nutrients into the cave.

Drainage Changes

The direction of surface water runoff during construction into sinkholes or other conduits leading into caves can carry significant quantities of sediment into cave streams. Sedimentation can alter or eliminate pool and stream habitats leading to reduction or extirpation of aquatic communities. Recharge points can be blocked and rechanneled elsewhere, or conversely, water formerly draining into multiple sinkholes can be channeled into a single sink or sinking stream. The result can be either a drastic increase/decrease of water volume and velocity or increased sedimentation or stream scouring (Keith 1988). Compaction of the surface alone has been associated with an 80 fold increase in the sediment load during a rainfall, which in turn was associated with a reduction in the density, abundance and diversity of cave stream invertebrates (Tercafs 2001).

Groundwater Contamination

During the fieldwork for this project, Stab residents reported a historic occurrence of a gasoline tanker truck wreck that resulted in the discharge of its cargo into a sinkhole adjacent to a county road. Subsequently, the odor of gasoline could be detected for several days at Short Creek. Though anecdotal, this illustrates the propensity of highways to lead to the contamination of caves and their groundwaters by hazardous materials after accidental spills. The presence of highways in the vicinity of caves and sinkholes also leads to the possible ingress of petroleum products and road salt.

Trogloxene Foraging Habitat Destruction

As noted above, cave communities in the project area are dependent upon the importation of food from the surface. In particular, animals like cave crickets or woodrats forage in the proximity of any hole that allows egress to the surface. Disturbance of the surface foraging habitat within approximately 500 feet of any cave entrance, crevice or sinkhole potentially stops or inhibits, depending on the nature and extent of the disturbance, cave cricket feeding. Much of the unique terrestrial troglobitic community of the project area inhabits the guano veneers left on cave walls by these crickets. Thus, to disturb the foraging grounds of the crickets is to disturb the underlying cave community. See Section 5.0 (Suggested Mitigation and Compensation Measures) for discussion of mitigation to the karst ecology.

5.2.18 Impacts to Rare Karst Fauna by Alternative

Impacts to rare karst fauna are difficult to quantify. For the purpose of evaluating the potential I-66 build alternatives a matrix was developed to assist in the assessment of impacts to rare karst fauna. The foraging range of trogloxenes (500 feet) referenced in the Karst and Geohazard Study was used as a disturbance buffer around the karst openings where the subterranean fauna scored a Composite Community Rarity Score (CCRS) of 10 or greater. The area of disturbance (in square feet) from each alternative within the disturbance buffer for each of these openings was multiplied by the CCRS. The multiplied values for each disturbance were totaled and then divided by 100,000 to yield the Alternatives Karst Fauna Rarity Disturbance Score (KRDS). A higher KRDS is indicative of a greater disturbance to rare karst fauna. The KRDS of each build alternative in Pulaski County is listed below, from highest to lowest:

- Alternative K 553
- KY80 Modified 483
- KY80 Shifted 238
- Alternative D 141
- Alternative B 77
- Alternative B-D 77

Alternative K is presumed to have the greatest impact to rare karst fauna with a KRDS of 553. Alternatives B and B-D have the least impact to rare karst fauna with a KRDS of 77.

5.2.19 Avoidance/Mitigation of Karst Fauna Impacts

All proposed bands for I-66 cross karst, as well as cave systems inhabited by many species of globally rare cave invertebrates. All caves, regardless of size, should be considered significant since almost every site sampled demonstrated globally rare fauna. Cave entrances, as well as streams draining into caves or swallets, should be avoided. Much of the terrestrial troglobitic fauna of the area is dependent upon cave crickets for importation of food. These crickets forage on the surface in a 500+ foot radius from cave entrances as well as any hole or fissure allowing egress from the cave. Thus, protection of the cave fauna requires preservation of the cave entrance and, where practicable, protection of a 500 foot radius all around the cave. For the purposes of mitigation, a cave is defined as an opening into the subterranean system with a two foot diameter.

Cave Protection

Some caves within the project area are candidates for protection through gating, which should be initiated if current cave owners are willing. Careful consideration must be given before placing a gate on a cave, as architecture, engineering, construction, monitoring, maintenance and repair are important and require personnel and funding over a long period of time. Cave gates must be constructed in such a way that persons needing to access the site can gain access while vandals are excluded. Bats and other trogloxenic fauna must be allowed appropriate egress, while microclimates and nutrient input remain undisturbed. Powers-style angle iron gates, which have little impact on air flow, are preferable for caves which are known bat hibernacula or maternity roosts. The placing of gating should be coordinated with the USFWS Frankfort Field Office and the KDFWR. Sites appropriate for gating have been identified by members of the project team with HMB Professional Engineers, Inc. and Gannett Fleming, Inc. If a build alternative is selected and the option of cave gating is implemented, the KYTC District 8 Environmental Coordinator or the KYTC Division of Environmental Analysis should be contacted for more information about caves to be gated.

5.2.20 Karst Vulnerability Assessment Overview

The Karst Vulnerability Assessment (KVA) takes data collected during the karst inventory and field assessment and evaluates the potential for the development of epikarst/karst terrain; thereby, qualitatively determining the vulnerability of the karst ecosystem.
Determination of karst vulnerability followed the Karst Inventory Standards and Vulnerability Assessment Procedures for British Columbia, Version 2.0, and dated January 2003 (herein referred to as the BC procedure). The karst vulnerability assessment includes three interim developmental products as outlined in the above referenced British Columbia study: an evaluation of epikarst development, a determination of epikarst sensitivity, and a surface karst sensitivity determination. This assessment incorporated both identified surface karst features and subsurface data, i.e. carbonate strata contacts from Kentucky Geological Survey mapping, to produce a vulnerability rating for karst areas within the study bands.

For the assessment of the I-66 karst vulnerability, all identified surface karst features were considered "significant", which is a slight deviation of the BC procedure that sets minimum dimensions for "significant" features. By assessing all the surface karst features identified during the karst field assessment (KFA), the results are more conservative than would otherwise be determined. All of the deviations from the BC procedure were made to produce a more conservative result.

5.2.21 Karst Vulnerability Assessment Process

The karst vulnerability assessment (KVA) process identifies and evaluates the stage and sensitivity of karst development in an area. It follows a qualitative process to integrate the surface and subsurface data collected during the KFA to derive a vulnerability rating for the study area. The karst vulnerability assessment is performed in four steps. The first two steps evaluate the epikarst development potential and the sensitivity of the epikarst. Steps 3 and 4 rate the stage of karst development and the karst sensitivity. A brief description of the four steps follows:

1. Epikarst Development. Assesses the presence and stage of epikarst. This is accomplished by identifying epikarst surface features from the KFA inventory (those with surface expressions less than 3 feet wide in the maximum dimension). The depth and frequency per unit area of the surface epikarst features are compared to determine the Epikarst Development Rating. Areas with few and shallow occurrences receive a Slight rating. Areas with many and deep epikarst surface features receive a Very High rating.
2. Epikarst Sensitivity. This step compares the stage of Epikarst Development with the soil type and thickness. In the I-66 study area, all of the soil in the karst and epikarst areas is classified as fine-grained soils (low plasticity silt or clay); therefore no increase in the rating was applied. This step is assessed since the thickness and type of soil are directly related to the development of karstic terrain. Areas with deep soil cover and low development rating receive a Slight rating; contrastingly, areas with relatively thin soil cover or exposed bedrock and Very High Epikarst Development rating receive a Very High Epikarst Sensitivity rating.

3. Surface Karst Sensitivity. This step integrates the Epikarst Sensitivity rating with the Karst Surface Feature Density to produce the Surface Karst Sensitivity Rating. The most sensitive karst areas are those with a Very High Epikarst Sensitivity rating and a relatively large number of inventoried surface karst features. The BC procedure allows for a modification of this rating depending on the karst roughness, e.g., an indicator of the maturity of the karst terrain. Since the entire I-66 study area is at the same developmental stage, no modifier was applied to this rating.

4. Karst Vulnerability Rating. This last step takes the rating through Step 3 and integrates it with the Subsurface Karst Potential. For the I-66 assessment, this step was modified to reflect the findings of the Karst Fauna Study. As discussed in Section 3.8, the Karst Fauna study identified cave dwelling and cave-dependent species and their Global Rarity ranking (G-ranking). The modified ranking for the Subsurface Karst Potential is:

- Low – No Known Cave.
- Moderate – Cave without fauna.
- High – Cave with G4 and G5 species.
- Very High – Cave with G1, G2, or G3 species.

In addition to accounting for the rarity of cave fauna, a foraging area (500-foot radius) was buffered around all the caves and cave systems located or inferred during the KFA. This, like the other modifications to the BC procedures, results in a more conservative final *Karst Vulnerability Rating* then would otherwise be determine following the published procedure.
For more detailed descriptions of the methodology and GIS development of karst vulnerability mapping see the Karst and Geohazards Study (April 2005).

5.2.22 Karst Vulnerability Assessment Conclusions

The vulnerability study identified and inventoried the surface karst features within the portion of the three western bands that are underlain by carbonate bedrock. Features include: karrens, sinkholes, swallets, closed depressions, sunken valleys, grikes, springs, and caves. Features are classified as epikarst if the maximum feature diameter is 3 feet or less and karst if the maximum feature diameter is 4 feet or greater. The development of features from epikarst to karst occurs along a continuum. This study makes the distinction to help delineate areas of young and mature karst terrain since larger karst features are found in the more mature karst terrain and present greater challenges to a civil engineering project.

Table 5.2.22-1 summarizes the band areas underlain by carbonate bedrock (project area sections with karst potential) with the respective surface area percentage based on the Karst Vulnerability Ratings of Low, Moderate, High or Very High.

The results are fairly uniform for all three bands with the exception that the Sinking Valley cave system and the resulting buffered area between Price Cave and Quarry Sink skews the Very High rating for Band KY80. Geotechnical subsurface investigations and cave roof stability analyses should be used to assess the potential impact of the Very High and High areas related to caves. Bands B and D are predominated by epikarst features and Band KY80 is dominated by more mature karst features. Mitigation alternatives for epikarst may include geosynthetic separation and reinforcement and drainage diversion. Band KY80 is dominated by karst features. Mitigation alternatives for karst features include geosynthetic reinforced soil, concrete capping, reinforced bridging slab (land bridges), and deep foundations.

For a karst vulnerability plot see Figure 5.2.22-1 in Appendix C.

For additional detailed mapping, including vulnerability plots for each studied band, refer to the Karst and Geohazards Survey (April 2005).

Table 5.2.22-1 Karst Vulnerability by 1000ft Band (Pulaski Co. Only)

Karst Vulnerability Rating	Band KY80	Band B	Band D
LOW	46%	40%	53%
MODERATE	35%	35%	27%
HIGH	5%	20%	19%
VERY HIGH	14%	5%	1%

Impacts to Non-Karst Aquatic Systems

5.2.23 Impacts to Sole Source Aquifers

There are no EPA designated sole source aquifers within the project area.

5.2.24 Impacts to Surface Streams

Stream sampling sites shown in Figure 4.2.6-1 in Appendix C of this document. Aquatic fauna, stream conditions and associated impacts are discussed here.

Surface stream impacts, shown by alternative, can be looked at in various ways to get a complete picture of the amount and relative types of impacts associated with the I-66 project. Stream impacts are shown using the following types of impact criteria:

- Total stream impacts in linear feet per alternative.
- Total *perennial* stream impacts in linear feet per alternative.
- Perennial stream loss (accounting for those streams that will be bridged vs. those that will be diverted through culverts).
- Impacts to *intermittent and ephemeral* streams per alternative.
- Impacts to intermittent and ephemeral streams after accounting for alternative design differences and roadway channel footage (man-made ephemeral streams of poor quality).

5.2.25 Total Impacts to All Streams

Table 5.2.25-1 in Appendix C summarizes the streams impacted per alternative and the amount of impact per stream in linear feet. The alternatives are ranked per county according to the amount of impact (1 = least amount of impact). From Table 5.2.25-1, the Pulaski County alternative with the greatest amount of impacts to area streams is Alternative KY80-Modified (31,370.54 linear feet), with most of the impacts occurring to Price Valley (7,410.24 linear feet); however, Lacy Fork including its tributaries would suffer the greatest impacts by Alternative KY80-Modified, with a total of 8,969.95 linear feet. The alternative with the least amount of impacts to area streams in Pulaski County is Alternative B-D (11,935.84 linear feet). Among Laurel County alternatives, Alternative H has the greatest amount of impacts to area streams (21,469.42 linear feet), with the greatest impacts occurring to Ward Branch (2,996.36 linear feet). Alternative L has the least amount of impact to area streams (18,616.36 linear feet).

5.2.26 Total Impacts to *Perennial* Streams

Table 5.2.26-1 below, summarizes perennial stream impacts in linear feet. Table 5.2.25-1 on the following page lists the streams and their tributaries that may be impacted per alternatives. Each alternative is ranked according to the amount of impacts it has on the resource, with 1 representing the least amount of impact.

The Pulaski County alternative with the greatest amount of perennial stream impact is Alternative KY80-Modified with 26,041 linear feet of impact. The Laurel County alternative with the greatest amount of perennial stream impact is Alternative G with 23,642 linear feet; therefore, the alternative combination with the greatest amount of stream impact is KY80-Modified-G, with 49,683 linear feet of stream impact. The Pulaski County alternative with the least amount of perennial stream impact is Alternative B-D with 7,797 linear feet. Alternative I has the least amount of perennial stream impact (17,103 linear feet) of the Laurel County alternatives; therefore, *the alternative combination with the least amount of perennial stream impact is Alternative B-D-I, with a total of 24,900 linear feet of stream impact.*

(Continued Next Page)

Table 5.2.26-1 ***Perennial*** Stream Impacts per Alternative

Pulaski County Alternative	Impacts (in linear feet)	Alternative Ranking
K	19,926	4
KY80-Shifted	21,493	5
KY80-Modified	26,041	6
B	14,113	3
D	8,787	2
B-D	7,797	1
Laurel County	**Impacts (in linear feet)**	**Alternative Ranking**
G	23,642	5
H	17,293	3
I	17,103	1
L	17,278	2
M	21,797	4

5.2.27 Impacts to Streams After Accounting for Stream Bridges and Culverts

After accounting for streams that will be bridged versus those diverted through culverts, the perennial stream impacts are less than those depicted in Table 5.2.26-1, on the previous page, and are referred to as stream loss. Table 5.2.27-1 summarizes the perennial stream loss. Because final design was not available at the time this report was written, these numbers were generated for the purpose of alternative comparison, only, and represent stream ranking of potential perennial stream loss. They do not represent the actual numbers of stream loss that will occur during the construction phase of this project. Each alternative is ranked according to the amount of impacts it has on the resource, with 1 representing the least amount of impact.

The Pulaski County alternative with the greatest perennial stream loss is Alternative KY80-Modified (24,911 feet), while the alternative with the least perennial stream loss is Alternative B-D (6,651 feet). Among the Laurel County alternatives, Alternative M has the greatest perennial stream loss (20,247 feet), while Alternative H has the least (13,831 feet).

5.2.28 Intermittent and Ephemeral Stream Impacts

Table 5.2.28-1 summarizes the impacts to intermittent and ephemeral streams per alternative in linear feet. Each alternative is ranked according to the amount of impacts it has on the resource, with 1 representing the least amount of impact.
The Pulaski County alternative with the greatest impact to intermittent streams is Alternative D (20,097 feet), while the Laurel County alternative with the greatest number of impacts is Alternative H (21,528 feet); therefore, the alternative combination with the greatest amount of impacts is Alternative D-H, with a combined total of 41,625 feet. The least amount of impacts in Pulaski County would occur with Alternative B (13,636 feet), and Alternative M (16,945 feet) in Laurel County. *The alternative combination, therefore, with the least amount of impacts is B-M, with a combined total of 30,581 feet of intermittent stream impacts.*

The greatest amount of ephemeral stream impacts in Pulaski County is Alternative KY80-Modified (82,970 feet), while the Laurel County alternative with the greatest amount of impacts to ephemeral streams is Alternative G (45,684 feet). The combined total of impacts, if alternatives KY80-Modified-G were chosen would be 128,654 linear feet. The Pulaski County alternative with the least amount of ephemeral stream impacts is B-D (19,532 feet), while the Laurel County alternative with the least amount of impacts is Alternative I (29,483 feet); thus, *the alternative combination with the least amount of impacts is B-D-I with a combined total of 49, 015 linear feet.*

As with perennial stream impacts, the figures shown in Table 5.2.28-1 are misleading due to the type of impact that might occur. Final design is not available at the time of this writing; however, Table 5.2.28-2 accounts for some of the known or expected differences in bridging versus culverting streams and represents intermittent and ephemeral stream loss. Note that these numbers were generated for the purpose of alternative comparison only, and represent stream ranking of potential intermittent and ephemeral stream loss. They do not represent the actual numbers of stream loss that will occur during the construction phase of this project. Each alternative is ranked according to the amount of impacts it has on the resource, with 1 representing the least amount of impact.

Accounting For Design Differences and Roadway Ditches

After adjusting impacts to the intermittent streams to account for design differences, Alternative D (Pulaski County) and Alternative H (Laurel County) remain the alternatives with the greatest amount of impacts with 20,097 feet and 21,528 feet, respectively, of intermittent stream loss. Likewise, alternatives B (Pulaski County) and M (Laurel County) remain the alternatives with the least amount of impacts as intermittent stream loss with 13,636 feet and 16,945 feet, respectively.

After adjustments made to ephemeral stream impacts to account for design differences, alternatives KY80-Modified (82,673 feet) and G (45, 684 feet) remain the Pulaski and Laurel county alternatives, respectively, with the greatest amount of ephemeral stream impacts as stream loss. *Likewise, Pulaski County Alternative B-D (19,271 feet) and Laurel County Alternative I (29,483 feet) remain the alternatives with the least amount of impacts as ephemeral stream loss.*

An additional adjustment was made to the ephemeral stream impact calculations in which roadway channel footage was subtracted from the calculation. Roadway channels or ditches are man-made and are not considered good-quality ephemeral streams. A preponderance of roadway channels occur along KY80 and I-75, which assigns greater value to the alternatives associated with those roadways (i.e., Pulaski County alternatives KY80-Shifted, KY80-Modified, K, and the eastern portions of all Laurel County alternatives). Table 5.2.28-2, on the following page, is a summary of the estimated linear feet of ephemeral streams, after this adjustment. Each alternative is ranked as in previous tables.

The Pulaski County alternative with the greatest amount of impacts after the adjustment is Alternative D (19,671 feet), while the Laurel County alternative with the greatest amount of impacts is Alternative H (30,759 feet). Ranking changed after the adjustment for roadway channels. Before the adjustment, Pulaski County Alternative KY80-Modified had the greatest amount of impacts, along with Laurel County Alternative G. The total ephemeral stream impacts with the alternative combination D-H is 50,430 linear feet. The Pulaski County alternative with the least amount of impacts remains Alternative B-D (9,176 feet) after the adjustment, while the Laurel County alternative with the least amount of impacts is Alternative M (21,009 feet) after the adjustment. *The combination alternative with the least impacts to ephemeral streams after the adjustment dropped by 18,830 linear feet (from 49, 015 feet with Alternative combination B-D-I to 30,185 feet with Alternative combination B-D/M).*

Table 5.2.27-1 Impact to *Perennial* Streams after Accounting for Bridges and Culverts

Pulaski County Alternative	Impacts (in linear feet)	Alternative Ranking
K	18,512	4
KY80-Shifted	20,527	5
KY80-Modified	24,911	6
B	12,967	3
D	7,280	2
B-D	6,651	1
Laurel County Alternative	**Impacts (in linear feet)**	**Alternative Ranking**
G	19,102	4
H	13,831	1
I	15,614	2
L	15,750	3
M	20,247	5

Table 5.2.28-1 Impacts to *Intermittent* and *Ephemeral* Streams

Pulaski County Alternative	Intermittent Stream Impacts (in linear feet)	Alternative Ranking	Ephemeral Stream Impacts (in linear feet)	Alternative Ranking
K	17,140	5	77,171	5
KY80-Shifted	15,847	4	69,803	4
KY80-Modified	15,603	3	82,970	6
B	13,636	1	31,648	3
D	20,097	6	27,090	2
B-D	14,739	2	19,532	1
Laurel County Alternative	**Intermittent Stream Impacts (in linear feet)**	**Alternative Ranking**	**Ephemeral Stream Impacts (in linear feet)**	**Alternative Ranking**
G	17,961	2	45,684	5
H	21,528	4	37,404	4
I	19,237	3	29,483	1
L	17,961	2	30,661	3
M	16,945	1	29,499	2

5.2.29 Impacts to Special Status Streams

The Rockcastle River

The Rockcastle River (seen in figure 5.2.29-1) is a fourth order stream within the project area. It is a State Wild River (SWR) from KY 1956 at Billows, south past the southern boundary of the project alternatives. The DBNF is seeking a federal Wild and Scenic River determination, which would protect the river under the National Wild and Scenic Rivers act of 1968. The Rockcastle River has also been designated as an Outstanding State Resource Water (OSRW), and an Exceptional Water (EXCW) resource. The Rockcastle River is a cold-water aquatic habitat (CWA) known to harbor several rare fish, including the federal Species of Management Concern ashy darter, which was identified from a survey of the Rockcastle River, conducted for the project. The federally threatened plant, Virginia spiraea, is historically known to occur at several locations on gravel bars along the Rockcastle River within the project area; however, Virginia spiraea was not identified during searches for this species. KSNPC (2004 correspondence) reported that the reach of the Rockcastle River from Highway 192 North to US 25 is the location of a series of high quality gravel bar communities. The KSNPC endangered and federal Candidate (for listing), Fluted kidneyshell (Ptychobranchus subtentum) was identified from project field surveys of the Rockcastle River. Kentucky Senate Bill 138 (February 1972) establishes that any new crossing of the Wild River must occur within the available ROW for KY 80 due to its State Wild River status.

Table 5.2.29-1 is a summary of the impacts per alternative to the area within the Kentucky Wild and proposed National Wild & Scenic River Boundary and the Rockcastle River. Each alternative is ranked according to the amount of impacts it has on the resource, with 1 representing the least amount of impact. Acreages are those measured within the project ROW

The Pulaski County alternative with the greatest number of impacts to the Wild (& Scenic) River boundary area and the Rockcastle River is Alternative KY80-Modified (6.223 acres), while all Laurel County alternatives would have equal impacts to this area (13.809 acres, each); therefore, the alternative combination with the greatest number of impacts is KY80-Modified coupled with any Laurel County alternative. The Pulaski County alternative with the least number of impacts to the Wild (& Scenic) River boundary area and the Rockcastle River is Alternative K (5.416 acres); therefore, any Laurel County alternative combined with Pulaski County Alternative K has the least amount of impacts to this ecological resource.

Sinking Creek

Sinking Creek begins in the western end of the Project Corridor as a first order stream, and grows to fourth order, before flowing outside the project corridor. Sinking Creek remains a fourth order stream until eventually flowing into the Rockcastle River south of the project area. It occurs partially within the DBNF in Laurel County and is an OSRW. Mussel surveys confirmed the presence of the federally endangered mussels, Cumberland bean (Villosa trabalis) and Cumberland elktoe (Alasmidonta atropurpurea) (Groves and Schuster 2000) in Sinking Creek occurring at a site from Willie Green Road to Carmichael Road, directly downstream from Alternative I. That reach has been designated by the USFWS as "Critical Habitat" for A. atropurpurea. Critical Habitat are "specific geographic regions, whether occupied by a listed species or not, that are essential for its conservation and that have been formally designated by rule"[3]. According to the KSNPC, a high quality population of the Cumberland bean mussel inhabits Sinking Creek. Any perturbations upstream will affect this downstream reach. Directly upstream from the designated Critical Habitat, a stretch of Sinking Creek exhibits signs of degradation. This stretch includes a section from about 200 stream feet downstream of the Sinking Creek and the Powder Mill Creek confluence downstream to the Laurel Branch Confluence. Habitat Assessment Field Data sheets scores for mussel survey sites within this section of Sinking Creek indicate "Not Supporting" status. In general, this section shows signs of bank instability and sedimentation. *From table 5.2.25-1 (in Appendix C), all Laurel County alternatives will have a similar direct impact (in terms of length of disturbance) to Sinking Creek with alternatives ranging from 352.27 linear feet (Alternatives G and M) to 314.73 linear feet (Alternative L).*

[3] http://endangered.fws.gov/glossary.pdf

Buck Creek

Buck Creek (shown in figure 5.2.29-2) is an exceptional stream with abundant karst features and clifflines. It provides habitat for a diversity of wildlife and has the largest concentration of threatened and endangered species records within the study corridor. From River Mile (RM) 62.6 to RM 28.9, Buck Creek is listed as an EXCW, a Reference Reach Stream (R_RCH), and an OSRW. From RM 53.3 to RM 10.5, Buck Creek is an OSRW. All of Buck Creek within the project area has been designated by the USFWS as Critical Habitat for Cumberlandian combshell and Oyster mussel (See previous description of Sinking Creek for definition of Critical Habitat). Any east/west alignment through the project area will impact this stream. Of the build alternatives, Alternative D crosses Buck Creek at the best habitat for Cumberlandian combshell and Oyster mussel. Substrates here are near optimal for these species in many locations. Alternatives K, KY80 Modified, KY80 Shifted, B and B-D all cross near the existing KY80 crossing where riparian vegetation has been previously impacted from KY80 construction and bedrock lies closer beneath loose substrates. *The Pulaski County alternative with the greatest impact to Buck Creek is Alternative KY80-Modified (5.15 acres), while the alternative with the least amount of impacts is Alternative B-D (1.00 acres). No Laurel County alternative has impacts to Buck Creek; therefore, any alternative combination impacts will be equal to the impacts of the Laurel County alternative of the alternative combination.*

Table 5.2.28-2 **Adjusted** Impacts to *Intermittent* and *Ephemeral* Streams

Pulaski County Alternative	Intermittent Stream Loss (in linear feet)	Alternative Ranking	Ephemeral Stream Loss (in linear feet)	Alternative Ranking
K	17,140	5	76,910	5
KY80-Shifted	15,760	4	69,506	4
KY80-Modified	15,516	3	82,673	6
B	13,636	1	31,387	3
D	20,097	6	26,829	2
B-D	14,739	2	19,271	1
Laurel County Alternative	**Intermittent Stream Loss (in linear feet)**	**Alternative Ranking**	**Ephemeral Stream Loss (in linear feet)**	**Alternative Ranking**
G	17,961	2	45,684	5
H	21,528	4	36,793	4
I	19,237	3	29,483	1
L	17,961	2	30,661	3
M	16,945	1	29,499	2

Table 5.2.29-1 Impacts to Area within the Kentucky Wild (Proposed National Wild & Scenic) River Boundary and the Rockcastle River

Pulaski County Alternative	Total Impacts (in acres)	Alternative Ranking
K	5.416	1
KY80-Shifted	5.486	4
KY80-Modified	6.223	5
B	5.464	3
D	5.453	2
B-D	5.453	2
Laurel County Alternative	**Total Impacts (in acres)**	**Alternative Ranking**
G	13.809	N/A
H	13.809	N/A
I	13.809	N/A
L	13.809	N/A
M	13.809	N/A

Figure 5.2.29-1 – Rockcastle River at KY80

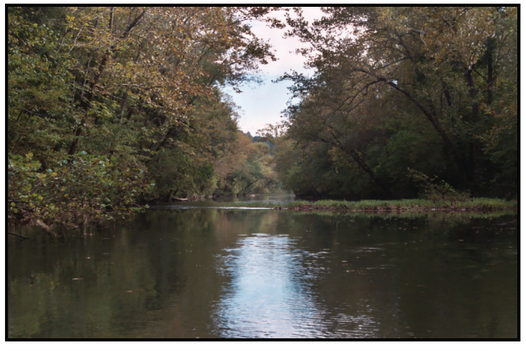


Figure 5.2.29-2 – Buck Creek at Alternative D

Stream and Aquatic Resource Mitigation

Measures to Minimize and/or Mitigate Impacts to Waterways

5.2.30 Erosion Control

Measures to control and minimize erosion and water quality impacts from construction activities will be incorporated into the project. Best Management Practices, standard erosion control measures, and other measures included in the Special Provisions and KYTC Standard Specifications for Road and Bridge Construction will provide the basis of the erosion control plan included for this project. Publications regarding BMP's for construction practices and related clean water issues are available from the KDOW, entitled "Kentucky Best Management Practices for Construction Activities"[4], "Kentucky Erosion Prevention and Sediment Control Field Guide," and "Effluent Guidelines for Construction and Development"[5].

The plan will include measures such as berms, dikes, silt fences, geotextile filter cloths, slope drains, mulched seeding, riprap, and sediment traps and basins to keep silt, sediment or other construction related pollutants from entering waterways during construction. Any of these items required for the final design will be specified in the contract proposal through details in the plans and/or special provisions. Permanent erosion control features such as seeding and/or planting trees will be incorporated into the project at the earliest practicable time as construction progresses.

Seeding on cut and fill slopes will be provided. Mulch and seed mixtures will be placed as early as practicable to minimize the area of bare soil exposed at any one time by construction operations. Temporary erosion protection with mulches, biodegradable fiber mats, and non-petroleum dust palliatives will be utilized in the project as directed by the project engineer. DO NOT MOW OR SPRAY signs will be posted along the proposed ROW wherever mitigation plantings have been established. A suggested seeding mix and tree and shrub species for planting along channel and riparian areas is given in the Ecology Baseline.

[4] http://www.water.ky.gov/dw/profi/tips/bmp.htm
[5] http://www.water.ky.gov/sw/nps/Publications.htm

5.2.31 Waterways and Riparian (Located on the Bank of a Natural Watercourse) Vegetation Mitigation

The KYTC Standard Specifications for Road and Bridge Construction will guide construction activities. Best Management Practices (BMP) will be utilized to prevent non-source point pollution, to control stormwater runoff and to minimize sediment damage to water quality and aquatic habitats.

Surface Run-off

The surface run-off of vehicular pollutants is unavoidable; due to the small quantities of such pollutants, no adverse impacts are anticipated. Accidental spills cannot be assessed, but emergency procedures are in place in Kentucky to report, contain and clean-up hazardous materials.[6]

Physical Disturbance (Including Large Trees Used by Protected Bats)

Physical disturbance of the waterways and riparian vegetation, especially large trees, would be limited to only that which is absolutely necessary to complete the project. Notes and details will be included in the plans to further minimize the removal of trees and understory vegetation that fall within the required ROW, but outside the actual limits of construction. The removal of hollow trees, trees with sloughing bark, and other large trees that fall within the project limits will be avoided to the maximum extent practical and delineated by special notes in the plans.

Particular attention will be given to the size, shape and stability of the natural stream channel in determining the need for stream encroachments and/or relocations. Crossings in known foraging and nursery habitats of the gray and Rafinesque's big-eared bats would be limited. See Section 5.2.48 (Endangered Species). Appropriate coordination with the USACOE, and the KDOW will be undertaken to develop a stream mitigation plan for those reaches impacted by construction activities. Mitigation would likely be sought within the same watershed as the affected stream.

Natural Stream Channel Disturbance and Replacement

The size, shape and stability of natural stream channels unavoidably impacted by construction will be used as the basis for designing replacement channels. During final design of the selected alternative, opportunities to restore existing unstable streams which are near the alignment, but outside of the disturbance limits, will be investigated. Degradation of streambeds, and erosion and sloughing of unstable banks contribute significant amounts of silt and sediment in unstable stream systems. Specifically, severely eroding banks are present on Sinking Creek at the crossings of alternatives L, H, and I, which are a threat to mussel populations in the Designated Critical Habitat section downstream. In the event that one of those alternatives is chosen for final design, mitigation could include the purchase by the KYTC of a section of Sinking Creek and about 60 feet (about 18 meters) of riparian zone on either side of its banks upstream from the Proposed Designated Critical Habitat for restoration purposes if property owners at this location are willing sellers. Restoration of this section of the stream would have a beneficial affect on all freshwater mussel species downstream within the Designated Critical Habitat, including KSNPC and federal listed species. See Section 5.2.51 (Freshwater Mussels).

River Crossings and Work in Existing Streams

Work in the low-water channel of existing streams will be minimized to the maximum practicable extent by limiting construction to the placement of required drainage structures or structure components such as piers, pilings, footings, cofferdams (temporary barrier for excluding water from an area that is normally submerged), shaping of fill slopes around bridge abutments and placement of riprap. Best Management Practices will be followed to prevent downstream siltation during cofferdam dewatering. ***Crossings that might occur over the Rockcastle River, Sinking and Buck creeks would be spanned completely from floodplain to floodplain, with no piers, pilings and/or footings, cofferdams or abutments in the water. Bridges over the Rockcastle River, and Buck and Sinking creeks will be designed with a closed deck drainage system, such that water draining the deck does not directly enter the stream.***

Native trees and shrubs will be planted along the top of the bank to replace woody vegetation removed during construction. (See the Ecology Baseline report for a list of suggested species for re-vegetating riparian and channel areas.) This list includes seeds of some nonnative grass species due to the quickness of their establishment. Quick establishment of vegetative cover protects the banks from erosion and reduces the likelihood and severity of soil eroding into the streams.

The contractor will comply with KRS 224.16-070 during bridge or other construction near streams and will not initiate construction activities prior to acquisition of all necessary permits, including either the General Certification (Nationwide Permit #14), or the individual Water Quality Certification. The General Certification does not apply to those waters of the Commonwealth identified as ORW, EXCW or CWAH Waters, as designated by the KDOW. An individual Water Quality Certification along with a detailed sediment and erosion control plan will be necessary for projects near these waters[7], which include the Rockcastle River, Buck Creek and Sinking Creek. These streams are designated as an OSRW (Rockcastle River, Buck Creek and Sinking Creek), an EXCW (Rockcastle River and Buck Creek), and a CWAH (Rockcastle River). Additionally, because the Rockcastle River is designated as a state Wild River, a Change-of-Use permit and written authorization from the Secretary of the Environmental and Public Protection Cabinet must be obtained before any construction activity is begun.[8]

The contractor will adhere to all conditions and restrictions set forth by the KDOW including the following:

- Any stream-disturbing activities which are not a part of the design plans, but which may be necessary during construction, may require state and federal permits. The contractor will contact KYTC and obtain any required permits before proceeding with the work.
- Stream and riparian impacts will be limited to the minimum necessary to construct the road crossing.
- All equipment access and excavations within a stream, necessary to complete a road-crossing project, shall be done in such a manner as to prevent degradation of waters of the Commonwealth. Temporary equipment crossing structures shall be constructed with sufficient pipe capacity so as not to impede normal stream flow.

[6] Kentucky Emergency Operations Plan http://kyem.dma.ky.gov

[7] http://www.water.ky.gov/permitting/wqcert/Nationwide-14.htm
[8] http://www.water.ky.gov/permitting/wildrivers

- Stream bed gravel and rock shall not be used for construction material.
- The stream crossing structure shall be constructed in such a manner that does not impede the movement of aquatic organisms. The bottom of any culverts shall be level with the stream bed[7].

Zebra Mussel Precautionary Measures

The zebra mussel (Dreissena polymorpha) is a highly invasive nonnative mussel species that has caused serious economic and ecological damage throughout the United States. The adults spread by attaching themselves to boating vessels and trailers, and construction equipment and the veligers (tiny free-swimming larvae of adult Zebra mussel) are spread through the dumping of ship ballast water. After becoming established in new waters, zebra mussels proliferate, outcompete native mussel species, alter the aquatic habitat, damage aquatic vessels and clog intake valves. It is illegal to import or possess zebra mussels in Kentucky, and a federal statute and an Executive Order were enacted in an attempt to control the spread of these exotic invasive species. Executive Order 13112 was enacted "to prevent the introduction of invasive species into the natural environment and provide for their control and minimize the economic, ecological and human health impacts that invasive species may cause"[9]. To this end, federal agencies are directed to attempt to prevent the introduction or spread of invasive species when their actions have the potential to do so.[8]

The Nonindigenous Aquatic Nuisance Prevention and Control Act (16 U.S.C. 4701-4751) was enacted "to prevent the unintentional introduction and dispersal of nonindigenous species into waters of the United States,...to carry out environmentally sound control methods to prevent, monitor and control unintentional introductions of nonindigenous species,...and to minimize economic and ecological impacts of nonindigenous aquatic nuisance species that become established, including the zebra mussel".[8] In order to comply with Executive Order 13112 and the Nonindigenous Aquatic Nuisance Prevention and Control Act, and in an attempt to prevent infesting area streams with zebra mussels, construction equipment will not be permitted to enter any perennial stream channel during the construction of this project. When and where temporary perennial stream crossings are necessary, the Division of Environmental Analysis of KYTC will be notified and temporary stream crossing structures (mentioned in bullets three and five in previous discussion) will be constructed with clean quarried rock in such a manner that no equipment enters the water. All perennial streams will be identified as such on the design plans with a note detailing the conditions noted in the preceding sentence above. In addition, the contractor shall sign a written statement of certifications stating that no equipment that is used within or near streams has been used within streams in drainages infested with zebra mussels for a period of at least 15 days. These restrictions will be strictly adhered to. All area streams are tributaries of Buck Creek, Sinking Creek or the Rockcastle River which, in addition to being KDOW designated Special Use Waters, harbor federally and KSNPC listed mussels. Established zebra mussel populations in tributaries upstream of Buck Creek, Sinking Creek or the Rockcastle River would most likely quickly invade those Special Use Waters, which would adversely impact native mussel populations in those streams.

Timing and Coordination of Aquatic Mitigation Plan Detail

Details of the mitigation for stream impacts requiring local, state, or federal permits, certifications or other approvals will be developed during the final design. Any known gray, Indiana, or Rafinesque's big-eared bat foraging and nursery habitat boundaries will be provided to the KYTC, Division of Environmental Analysis (DEA) by the Environmental Consultant and included in the final plans.

Impacts to Wetlands

5.2.32 Significance of Wetland Impacts

Wetlands are one of the most productive ecosystems on earth, producing large quantities of plants, some of which cannot be found anywhere else. Wetland plants provide forage, breeding habitat, and cover for countless wildlife species. Wetlands serve as breeding grounds and stopovers for many migratory bird species, and harbor one third of the nation's threatened and endangered species. Identification of jurisdictional wetlands early in the environmental phase is intended to guide the final design of the project to avoid these areas, minimize impacts if avoidance is not possible, and finally, mitigate for any unavoidable wetland loss. This is consistent with current KDOW and USACOE policy of avoiding, minimizing and mitigating wetland loss (if avoidance is not possible) in order to select the least environmentally damaging practicable alternative (LEDPA). This report and supporting data will be used to obtain a Jurisdictional Determination from the USACOE and will eventually be used to obtain a Section 404 permit for the preferred alternative selected from the Environmental Impact Statement (EIS) process.

5.2.33 Types of Wetland Impacts Associated with Project Related Activities and Their Effects on Wetland Communities

For the I-66 project, three primary types of wetland impacts have been considered for the wetland impact analysis: direct impacts, indirect impacts and water body modifications.

Direct Impacts to Wetlands

Direct impacts occur when the construction of the ROW encroaches upon a jurisdictional wetland. The area of wetlands located within the proposed ROW will be unable to function as a jurisdictional wetland subsequent to construction. However, the portions of the wetland outside of the construction ROW may continue to exist and will be subject to indirect impacts.

The construction of any of the build alternatives may alter the hydrology and drainage patterns of the wetlands within the project area. These alterations may affect groundwater, flood control, increase erosion and remove wildlife and aquatic habitat. In addition to providing wildlife/aquatic habitat, wetlands serve a variety of other functions including groundwater recharge/discharge, flood control, sediment stabilization/toxicant retentions and nutrient removal/transformation.

A large percentage of the jurisdictional and nonjurisdictional wetlands within the project area are small (less than one acre) palustrine wetlands. Construction of an Interstate on one of these areas would most likely fill the entire site. Even small palustrine wetlands can play an important role in protecting wetland-dependent species. Small wetland sites are more variable than larger complexes in the number of individuals of a species they contain. Small wetlands may function as a "source" to produce surplus individuals, which can colonize nearby wetlands whose populations have declined. The ability of many wetland-dependent species to migrate between larger wetlands is often dependent on smaller wetlands that act as stepping-stones. Removal of these small wetlands can reduce the ecological connectivity of larger complexes and may cause local extinctions. Conversely, small wetlands can act as an "ecological sink," (i.e., a habitat that appears to be suitable, but which fails to provide the necessary components for the successful reproduction of inhabiting organisms) (Florida Gulf Coast University 2000).

Indirect Impacts to Wetlands

Indirect impacts, which are caused by the action and typically occur later in time, can include changes in wetland function due to direct impacts or changes in wetland function that eventually occurs subsequent to the completion of a transportation project.

Indirect impacts to wetlands can be divided into two categories: those that are an immediate result of a direct ROW impact, and the indirect impacts that will occur later in time as a result of the proposed action. Indirect impacts that are an immediate result of a direct ROW take to a specific site are those that will occur during construction of the proposed project. Indirect impacts are those in which the primary function of the site and/or at least one of the three wetland criteria (soils, vegetation and hydrology) are affected by means other than a direct ROW take (e.g. filling or excavation of the site). The primary function of wetlands within the project area may be affected indirectly by the following factors (individually described on the following page):

- Site bisection
- Fragmentation
- Hydrology alteration or removal
- Proximity of the project to wildlife habitat
- Creation of barriers to species and processes
- Down-cutting of wetland streams
- Increased sediment load of wetland streams
- Shading

[9] Federal Register/ Vol. 69, No. 88/ Thursday, May 6, 2004

Site bisection refers to a wetland that is divided into one or more separate wetlands. Bisection occurs when the direct take of ROW is less than the total area of the wetland. The consequences of site bisection are unique to a given site, but may include loss of hydrology, creation of barriers to species, and the introduction of exotic invasive species.

Fragmentation of a wetland occurs when the direct take is relatively large in comparison to the wetland size. When fragmentation occurs, the remaining area is unlikely to function as a wetland. The fragments may simply be too small to retain its function as a wetland, or the large disturbance caused by the roadway may have destroyed the physical processes that initially created the wetland. Functionality can be lost due to loss of hydrology, removal of vegetation, change in the bottom substrate and/or loss of aquatic habitat.

Loss of hydrology occurs when natural watershed boundaries and subsurface flows are altered. Construction of a roadway may alter hydrology by placing fill, creating physical barriers, and excavating ditches. Placing fill and creating physical barriers can prevent overland flow or change topography, which may alter the directional flow for a given watershed. The excavation of ditches can potentially alter subsurface flow by creating a depression in which water will preferentially flow.

Proximity impacts can occur when the project alters wildlife habitat. This occurs when construction activities cause significant and lasting changes in the floral and faunal communities through disruption of the natural environment.

Creation of wildlife barriers between a wetland habitat and adjacent habitats disrupts faunal movement. Additionally, natural processes can be impacted by the creation of barriers. For example, riffle and pool complexes can be greatly affected by changes resulting from the placement of a bridge or a roadway. Riffles and pools provide local scale niches for macroinvertebrates and provide areas for larger animals such as fish to spawn, feed, and rest.

Down cutting occurs when a portion of a stream is straightened or significantly realigned. Straightening a stream increases the stream velocity and removes meanders. Meanders absorb the energy of a stream by diverting the direction of flow. When meanders are removed, the stream will down-cut and lose energy along the length of stream rather than just at the outside bends. This can cause bridge and roadway instability as well as increased bank erosion.

Increased sediment load is caused by erosion of stream bank during construction activities such as construction of piers, excavating for abutment, and placement of riprap. Increased sediment load can fill in riffles and pools, vital habitats for aquatic fauna. If the sediment has a high organic content, the sediment can lead to hypoxic (low oxygen) conditions as bacteria breakdown the organic portion. Sedimentation reduces light penetration and can kill aquatic flora. It can, also increase stream temperature, which reduces dissolved oxygen and stresses or kills aquatic organisms.

Shading occurs when a large bridge is constructed over a wetland. Shading can reduce primary productivity, leaving bare soil exposed and increasing the potential for erosion. Shading can also interfere with water temperature.

Water Body Modifications

Water body modifications relate to riverine and lucustrine wetland types and occur when an alteration to a water body is required to complete a selected action. When one or more of the three wetland criteria (hydrology, hydrophytic vegetation, and hydric soils) are affected by a project, a wetland previously determined to be jurisdictional, would lose that classification and, therefore, no longer be afforded protection under the USACOE guidelines. Water body modifications can result in direct and/or indirect impacts to a wetland.

5.2.34 Determining Wetland Impacts According to Wetland Classification

Wetlands are classified according to type (Cowardin et al. 1979), which is based on certain vegetation and hydrology characteristics. The following wetland types were identified from the proposed alternatives:

- Palustrine Unconsolidated Bottom (PUB)
- Palustrine Open Water (POW)
- Palustrine Emergent (PEM)
- Palustrine Forested (PFO)
- Palustrine Scrub-Shrub (PSS)
- Palustrine Emergent/Palustrine Unconsolidated Bottom PEM/PUB)
- Palustrine Emergent/Palustrine Open Water (PEM/POW)
- Palustrine Emergent/Palustrine Scrub-Shrub (PEM/PSS)
- Palustrine Scrub-Shrub/Palustrine Unconsolidated Bottom (PSS/PUB)
- Palustrine Scrub-Shrub/Palustrine Forested (PSS/PFO)
- Palustrine Emergent/Palustrine Forested (PEM/PFO)
- Palustrine Forested/Palustrine Unconsolidated Bottom (PFO/PUB)
- Palustrine Emergent/Palustrine Unconsolidated Bottom/Palustrine Forested (PEM/PUB/PFO)
- Palustrine Emergent/Palustrine Scrub-Shrub/Palustrine Unconsolidated Bottom (PEM/PSS/PUB)

5.2.35 Wetland Impacts per Wetland Type and by Alternative

Table 5.2.35-1 in Appendix C provides a summary of wetland impacts in acreage per wetland type (Cowardin et al. 1979) by alternative. From Table 5.2.35-1, the Pulaski County alternative with the greatest amount of impacts to wetlands is KY80-Modified (10.485 acres), while the alternative with the least amount of impact to wetlands is Alternative B-D (4.132 acres). The Laurel County alternative with the greatest amount of impact to wetlands is Alternative G (18.103 acres), while the alternative with the least amount of impact is Alternative I (6.799 acres). More detailed wetland survey information and data can be found in the Terrestrial and Aquatic Baseline Report.

5.2.36 Alternative Rankings Based on Wetland Impact Type

Table 5.2.36-1 is a summary of total weighted wetland impacts (i.e., wetland Cowardin types [Cowardin et al. 1979] were weighted based on wetland function and value). The alternatives are ranked by county according to the amount of impacts to wetlands (where 1 equals the least amount of impacts). See Section 4.2.8 for details on weighting system for ranking alternatives.

From Table 5.2.36-1, the Pulaski County alternative with the greatest amount of weighted impacts to wetlands is KY80-Modified (20.344 acres), while the alternative with the least amount of impacts is Alternative B-D (8.103 acres). The Laurel County alternative with the greatest amount of weighted impacts is Alternative G (37.862 acres), while the alternative with the least amount of impacts is Alternative I (11.573 acres).

5.2.37 Alternative Ranking Based on Wetland Type after Adjustment for Roadside Drainages

The ranking and impact figures shown above in Table 5.2.36-1 is slightly misleading due to existing ROW roadside drainages, especially along KY80 and I-75 (Laurel County). For this reason, roadside drainage acreage from the disturbance areas within the project area were subtracted from the original wetland acreages. Table 5.2.37-1 depicts a more accurate picture of impacts to wetlands per alternative.

Table 5.2.36-1 Wetland Impacts Based on Assigned Impact Value (including roadside drainages)

	Total Impacts (in acres)	Total Weighted Impacts (in acres)	Alternative Ranking per County
Pulaski County Alternative			
K	7.563	14.612	4
KY80-Modified	10.485	20.344	6
KY80-Shifted	8.189	15.427	5
B	5.743	13.026	3
D	5.078	9.282	2
B-D	4.132	8.103	1
Laurel County Alternative			
G	18.103	37.862	5
H	15.891	25.709	2
I	6.799	11.573	1
L	16.691	30.930	3
M	15.802	31.250	4

Table 5.2.37-1 Adjusted Wetland Impacts Based on Assigned Impact Value (excluding roadside drainages)

	Total Impacts (in acres)	Total Weighted Impacts (in acres)	Alternative Ranking per County
Pulaski County Alternative			
K	4.04	7.19	4
KY80-Modified	7.10	13.19	6
KY80-Shifted	4.80	8.24	5
B	2.54	4.99	2
D	3.44	5.79	3
B-D	1.92	4.22	1
Laurel County Alternative			
G	5.91	14.10	2
H	14.68	23.93	4
I	5.64	10.10	1
L	13.51	22.84	3
M	14.69	25.51	5

From Table 5.2.37-1, the Pulaski County alternative ranking changed slightly from that before the adjustment. Alternative B-D still has the least amount of weighted impact to wetlands (4.22 acres), while Alternative KY80-Modified still has the greatest amount of weighted impacts (13.19 acres); however, Alternative B is ranked second (4.99 acres), while Alternative D has slipped to third in ranking (5.79 acres). The greatest changes in ranking and impacts occurred among Laurel County alternatives. While Alternative I still has the least amount of weighted impacts to wetlands (10.10 acres), Alternative M has the greatest amount of impacts (25.51 acres). Alternative G is ranked second (14.10 acres) versus fifth before the adjustment; Alternative H is ranked fourth (23.93 acres) versus second ranking before the adjustment.

5.2.38 Jurisdictional vs. Non-Jurisdictional Wetlands

Table 5.2.38-1 (Impacts to Jurisdictional Wetlands per Wetland Type by Alternative) and Table 5.2.38-2 (Impacts to Non-jurisdictional Wetlands per Wetland Type by Alternative) provide summaries of the amount of impacts to jurisdictional and nonjurisdictional wetlands, respectively, per wetland Cowardin type by alternative. Each alternative is ranked according to the amount of impacts to jurisdictional and non-jurisdictional wetlands, separately (1 corresponds to the least amount of impacts). From Table 5.2.38-1, the Pulaski County alternative with the greatest impacts to jurisdictional wetlands is Alternative KY80-Modified (9.835 acres), while the alternative with the least amount of impacts to these wetlands is Alternative B-D (3.262 acres). In Laurel County, the alternative with the greatest amount of impacts to jurisdictional wetlands is Alternative G (13.843 acres), while the alternative with the least amount of impacts to these wetlands is Alternative I (5.854 acres). From Table 5.2.38-2, the Pulaski County alternative with the greatest impact to nonjurisdictional wetlands is Alternative D (1.555 acres), while the alternative with the least amount of impacts to these wetlands is Alternative KY80-Modified (0.649 acres). The Laurel County alternative with the greatest amount of impacts to nonjurisdictional wetlands is Alternative L (3.765 acres), while the alternative with the least amount of impacts is Alternative I (0.944 acres).

Impacts to jurisdictional wetlands within the project area far exceed those to nonjurisdictional wetlands. Pulaski County Alternative KY80-Modified, for instance, has more than 15 times as many jurisdictional as non-jurisdictional wetlands. See Section 4.2.8 for discussion of definitions and determination of jurisdictional vs. non-jurisdictional wetlands.

5.2.39 Wetland Impact Mitigation

Wetland Impacts Minimization/Mitigation

The "Memorandum of Agreement (MOA) between the Environmental Protection Agency and the Department of the Army concerning the Determination of Mitigation Under the Clean Water Act, Section 404(b)(1) Guidelines" (1989) expresses the explicit intent of the USACOE and USEPA to implement the object of the Clean Water Act to restore and maintain the chemical, physical, and biological integrity of the nation's wetlands, and to strive to achieve a goal of no overall net loss of values and functions.

Potential adverse environmental impacts to the wetlands must be avoided to the maximum extent practicable. Section 230.10 of the Guidelines requires that "no discharge will be permitted if there is a feasible alternative to the proposed discharge, having less adverse impacts to the wetlands, provided the alternative does not have other major environmental impacts."

When adverse impacts to wetlands are unavoidable, appropriate compensatory mitigation of the impacted wetland is required. When determining compensatory mitigation, the functional values of the impacted resource must be considered. When possible, any necessary mitigated wetlands, including wetland creation or restoration, will be constructed on-site and in-kind. Where on-site mitigation is not feasible, other mitigation such as wetland banks or in-lieu-fee will be investigated.

Where alternative alignments cannot be located so as to avoid wetland impacts, every effort must be made to minimize the impacts. Special precautions should be taken so that excessive sediments do not enter the wetlands. Heavy equipment should not traverse or be parked on wetland areas.

Prior to construction, a wetland mitigation plan will be developed in accordance with mitigation requirements of 40 CFR Section 230 to address the replacement of wetland functions and values that may be unavoidably lost to construction.

Table 5.2.38-1 Impacts to *Jurisdictional* Wetlands per Wetland Type by Alternative (in acres)

	Pulaski County Alternatives						Laurel County Alternatives				
Cowardin [1] Wetland Type	**K**	**KY80-Modified**	**KY80-Shifted**	**B**	**D**	**B-D**	**G**	**H**	**I**	**L**	**M**
PUB	0.501	0.617	0.870	0.585	1.187	0.909	2.346	6.324	1.991	3.602	2.647
POW	0	0	0	0	0	0	0.304	0	0	0	0.216
PEM	5.061	7.882	5.284	3.084	0.823	0.877	6.686	2.861	2.674	2.660	4.405
PEM/PUB	0.214	0.214	0.096	0.214	0	0.118	0.154	0.646	0	0.294	0.491
PEM/POW	0.106	0.106	0.106	0	0	0	0	0	0	0	0
PEM/PSS	0.783	0.783	0	0.548	0.783	0.783	0.877	0	0	0.877	0.877
PSS/PEM	0	0	0.783	0	0	0	0	0	0	0	0
PSS/PFO	0	0	0	0	0	0	0.266	0	0.103	0.266	0.266
PEM/PFO	0.233	0.233	0.233	0	0	0	0.218	0.049	0	0	0
PFO/PUB	0	0	0	0	0	0	0	0	0.013	0	0
PFO	0	0	0	0	0	0	0.673	1.493	0.074	0.100	0
PSS	0	0	0	0	0.155	0	0.649	0.808	0.999	0.796	0.528
PEM/PUB/PFO	0	0	0	0	0.575	0.575	0	0	0	0	0
PEM/PSS/PUB	0	0	0	0	0	0	1.670	0	0	1.670	1.670
PSS/PUB	0	0	0	0	0	0	0	0.890	0	0.890	0.616
Total Impacts per Alternative	6.898	9.835	7.372	4.431	3.523	3.262	13.843	13.071	5.854	11.155	11.716
Alternative Rank by County	4	6	5	3	2	1	5	4	1	2	3

Table 5.2.38-2 Impacts to *Non-Jurisdictional* Wetlands per Wetland Type by Alternative (in acres)

	Pulaski County Alternatives						Laurel County Alternatives				
Cowardin [1] Wetland Type	**K**	**KY80-Modified**	**KY80-Shifted**	**B**	**D**	**B-D**	**G**	**H**	**I**	**L**	**M**
PUB	0.184	0.180	0.281	0.875	0.433	0.815	0.836	2.642	0.817	3.211	1.531
POW	0	0	0	0	0	0	0.944	0	0	0	0.099
PEM	0.285	0.274	0.282	0.380	0.342	0.342	0.492	0.176	0.127	0.407	0.467
PEM/PUB	0.195	0.195	0.195	0	0.780	0.780	0.147	0	0	0.147	0.147
PEM/POW	0	0	0.057	0.057	0	0.057	0	0	0	0	0
PEM/PSS	0	0	0	0	0	0	0	0	0	0	0
PSS/PEM	0	0	0	0	0	0	0	0	0	0	0
PSS/PFO	0	0	0	0	0	0	0	0	0	0	0
PEM/PFO	0	0	0	0	0	0	0	0	0	0	0
PFO/PUB	0	0	0	0	0	0	0	0	0	0	0
PFO	0	0	0	0	0	0	0.071	0	0	0	0.071
PSS	0	0	0	0	0	0	0	0	0	0	0
PEM/PUB/PFO	0	0	0	0	0	0	0	0	0	0	0
PEM/PSS/PUB	0	0	0	0	0	0	0	0	0	0	0
PSS/PUB	0	0	0	0	0	0	0	0	0	0	0
Total Impacts per Alternative	0.664	0.649	0.815	1.312	1.555	1.994	2.49	2.818	0.944	3.765	2.315
Alternative Rank by County	2	1	3	4	5	6	3	4	1	5	2

[1] From Cowardin et al. 1979
PUB = Palustrine Unconsolidated Bottom
PEM = Palustrine Emergent
PSS = Palustrine Scrub-Shrub
PEM/POW = Palustrine Emergent/Palustrine Open Water,
PSS/PUB = Palustrine Scrub-Shrub/Palustrine Unconsolidated Bottom
PEM/PFO = Palustrine Emergent/Palustrine Forested
PEM/PUB/PFO = Palustrine Emergent/Palustrine Unconsolidated Bottom/Palustrine Forested
POW = Palustrine Open Water
PFO = Palustrine Forested
PEM/PUB = Palustrine Emergent/Palustrine Unconsolidated Bottom
PEM/POW = Palustrine Emergent/Palustrine Scrub-Shrub
PSS/PFO = Palustrine Scrub-Shrub/Palustrine Forested
PFO = Palustrine Forested/Palustrine Unconsolidated Bottom

Why are wetlands important? Wetlands provide fish and wildlife habitats, water quality improvement, flood storage and recreational areas among others uses.
How do we mitigate wetland impacts? Wetland impacts can be mitigated in a number of ways, including; wetland creation where no wetland previously existed, wetland restoration through the re-establishment of a prior wetland and wetland protection.

Terrestrial Habitat Impacts and Mitigation

5.2.40 Daniel Boone National Forest (DBNF)

Impacts from the Proposed I-66 on the DBNF

The DBNF (shown in Figure 5.2.40-1), which is bisected by the project corridor, is home to numerous sensitive and rare animal and plant species, whose survival depends on habitat health and availability. Table 5.2.40-1, in Appendix C, lists those rare species which have been documented as occurring within the general project area, and Table 5.2.40-2, in appendix C, lists the projected impacts to rare species' potential habitat of the alternatives. Table 5.2.40-3, at right, lists the total direct impacts to the DBNF per alternative. Each alternative is ranked according to the amount of impacts it has on the resource, with 1 representing the least amount of impact.

Pulaski County alternatives D and B-D have the greatest total impacts to the Daniel Boone National Forest (15.22 acres, each). The Laurel County alternative with the greatest number of impacts is Alternative I with 365.99 acres; therefore, the alternative combinations with the greatest number of impacts per acre to the DBNF are B-D-I, and D-I, each with 381.21 acres of impact. In general, any combination of alternatives with Alternative I would result in impacts to the DBNF of over 370 acres, each, the greatest of any other combination of alignments. The alternative combinations with the least number of impacts per acre to the DBNF are KY80 Modified–G, KY80 Modified-L, and KY80 Modified-M, each with 197.16 acres. Alternative KY80-Modified (Pulaski County) has 5.09 acres of impacts to the DBNF; alternatives G, L, and M (Laurel County) each have 192.07 acres of impacts to the DBNF.

In a USFS/I-66 Project Team meeting held July 21, 2003, the USFS commented that the I-66 project has the potential to impact six of their prescription areas. The areas listed are Cliffline, Designated Old Growth, Habitat Diversity Emphasis, Riparian, Proposed Wild and Scenic River, and Significant Bat Caves.

<u>Cliffline Prescription Area Impacts</u>

The DBNF is replete with cliffline habitat within the proposed I-66 project area. Cliffline habitat harbors many rare and KSNPC listed species, including the KSNPC Species of Concern, Lucy Braun's white snakeroot (Ageratina luciae-brauniae) and Rafinesque's big-eared bat (Corynorhinus rafinesquii).

The DBNF defines a cliffline community as:
"...the area between 100-feet slope-distance from the top and 200-feet slope-distance from the dripline of a cliffline. A cliffline is a naturally occurring, exposed and nearly vertical rock structure at least 10 feet tall and 100 feet long. A cliffline is continuous if segments are separated by no more than 300 feet. Wherever the described conditions are found, those sites will be included in this Prescription Area."

For the purpose of this project, the DBNF's high probability cliffline buffer was used to represent Cliffline Prescription Areas. Ground truthing, conducted by the DBNF, has proven this buffer to be 80% accurate. Clifflines were found within or near all areas designated by this buffer during project studies.

Table 5.2.40-4 summarizes the impacts to the DBNF's High Probability Cliffline Buffer (Cliffline Prescription Area). Each alternative is ranked according to the amount of impacts it has on the resource, with 1 representing the least amount of impact.

The Pulaski County alternative with the greatest number of impacts to clifftop habitats within the DBNF is Alternative B with 7.893 acres, while the Pulaski County alternative with the greatest number of impacts to cliffbottom habitat is Alternative KY80-Modified with 12.102 acres. The Pulaski County alternative with the greatest number of impacts to total cliffline habitat within the I-66 project corridor is Alternative B with 19.307 acres to both habitats. The Pulaski County alternatives with the least amount of impact to clifftop habitat are alternatives D and B-D, each with 7.067 acres of impacts. Alternative B has the least amount impact to cliffbottom habitat with 11.414 acres. The Pulaski County alternative with the least amount of total impacts to clifftop and cliffbottom habitat is alternative KY80-Modified with 18.572 acres.

Alternative I is the Laurel County alternative with the greatest number of impacts to both clifftop and cliffbottom habitat within the DBNF with 27.905 acres of impacts to clifftop habitat and 58.626 acres to cliffbottom habitat (86.531 acres, combined). The Laurel County alternative with the least amount of impact to clifftop and cliffbottom habitat within the DBNF is Alternative H with 15.294 acres in clifftop habitat, 31.824 acres in cliffbottom habitat (47.118 acres total cliffline impacts).

<u>Designated Old Growth Prescription Area Impacts</u>

According to the DBNF Forest Plan:
"Old-growth forests are ecosystems distinguished by old trees and related structural attributes. Old-growth encompasses the later stages of stand development that typically differ from earlier stages in a variety of characteristics which may include tree size, accumulation of large wood material, number of canopy layers, species composition, and ecosystem function."

In the 2004 Forest Plan Old Growth Prescription Areas have been designated within the forest. These areas are managed in such a way as to promote the future development of old growth communities.

A Designated Old Growth Prescription Area occurs within the project area along White Oak Creek and is within the impact zone of Laurel County alternatives H and I. Table 5.2.40-5, on the following page, summarizes impacts to this area. Each alternative is ranked according to the amount of impacts it has on the resource, with 1 representing the least amount of impact.

None of the Pulaski County alternatives impact Old Growth Management Areas within the DBNF, nor do Laurel County alternatives G, L, or M. Laurel County Alternative I has the greatest impacts to Old Growth Management Areas (33.449 acres), and Laurel County Alternative H has 30.606 acres of impacts to this ecosystem.

Table 5.2.40-3 Total Impacts to the DBNF per Alternative ROW

Pulaski County Alternative	Total Impacts (in acres)	Alternative Ranking
K	5.90	2
KY80-Shifted	5.90	2
KY80-Modified	5.09	1
B	9.90	3
D	15.22	4
B-D	15.22	4
Laurel County Alternative	**Total Impacts (in acres)**	**Alternative Ranking**
G	192.07	1
H	258.77	2
I	365.99	3
L	192.07	1
M	192.07	1

Table 5.2.40-4 Impacts to DBNF High Probability Cliffline Buffers per Alternative

Pulaski County Alternative	Clifftop Impact (in acres)	Cliffbottom Impact (in acres)	Total Impacts to Clifflines	Alternative Ranking
K	7.160	11.936	19.096	4
KY80-Shifted	7.150	11.919	19.069	3
KY80-Modified	6.473	12.102	18.572	1
B	7.893	11.414	19.307	5
D	7.067	11.912	18.979	2
B-D	7.067	11.912	18.979	2
Laurel County Alternative	**Clifftop Impact (in acres)**	**Cliffbottom Impact (in acres)**	**Total Impacts to Clifflines**	**Alternative Ranking**
G	25.031	46.514	71.545	3
H	15.294	31.824	47.118	1
I	27.905	58.626	86.531	4
L	20.097	37.393	57.490	2
M	25.031	46.514	71.545	3

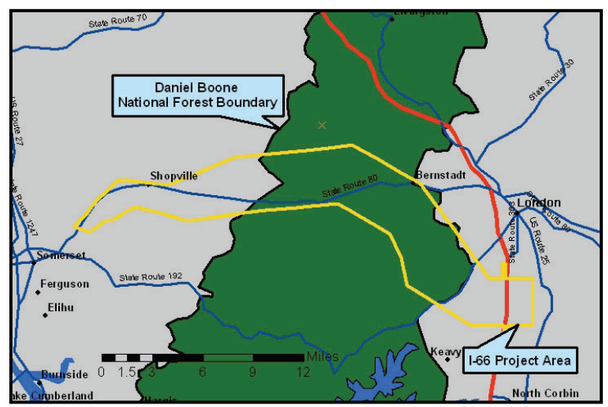


Figure 5.2.40-1 – Daniel Boone National Forest Proclamation Boundary

Habitat Diversity Emphasis Prescription Area

According to the Forest Plan:
"This matrix of diverse habitat unites the Forest landscape. Unless allocated to another Prescription Area, National Forest System land is allocated to the Habitat Diversity Emphasis Prescription Area. It may consist of small to large parcels that may be adjacent to, or possibly surrounded by, other Prescription Areas. Most forest and woodland in this Prescription Area is classified as suitable for timber production with timber production secondary to wildlife habitat and forest health management."

"This Prescription Area consists of a mixture of habitat conditions that provide a desired diversity of communities. The desired diversity includes major plant communities such as mixed mesophytic, upland oak and yellow pine forests, which include American chestnut and non-forest areas such as permanent shrub or grass openings. Diversity of habitats also includes variation in the density and kind of trees within a stand, the kinds and amounts of herbaceous and shrubby plants found under the forest overstory, and the vertical structure within a stand. ...This area is managed for the purpose of maintaining biodiversity."

From Table 5.2.40-5, the Pulaski County alternatives with the greatest impact to Habitat Diversity Emphasis Prescription Areas are alternatives B and B-D (12.91 acres, each), while Alternative KY80-Modified has the least amount of impacts to these areas (4.40 acres). Among Laurel County alternatives, Alternative I has the greatest impact to these prescription areas (198.72 acres), while Alternative H has the least impact (98.46 acres). Alternatives G, L, and M each have 112.40 acres of impact to these areas.

Riparian Prescription Areas

According to the DBNF Management Plan:
"The Riparian Corridor Prescription Area encompasses riparian areas, as well as adjacent associated upland components. A riparian area is functionally defined as a three-dimensional ecotone of interaction that includes both terrestrial and aquatic ecosystems. It is identified on the ground as one of the following: a perennial stream or other perennial water body (with the exception of artificial upland ponds and the Large Reservoirs Prescription Area), or an intermittent stream, as well as the associated soils, vegetation and hydrology. It extends down into the groundwater, up above the canopy, outward across the floodplain, up the near-slopes that drain into the water, laterally into the terrestrial ecosystem, and along the watercourse at a variable width.

"A riparian corridor is managed to retain, restore, and/or enhance the inherent ecological processes and functions of the associated aquatic, riparian, and upland components. Primarily, only natural processes (floods, erosion, seasonal fluctuations, etc.) modify the landscape and resources within the area."

Impacts to Riparian Prescription Areas were calculated via methods consistent with those of the USFS (USDAFS April 2003). From Table 5.2.40-5, the Pulaski County alternative with the greatest amount of impacts to Riparian Prescription Areas is Alternative K (112.75 acres), while the alternatives with the least amount of impacts are alternatives B and B-D (24.45 acres, each). The Laurel County alternative with the greatest amount of impacts to Riparian Prescription Areas is Alternative I (155.62 acres), while the alternative with the least amount of impacts is Alternative L (123.99 acres).

Significant Bat Caves within the DBNF

According to the DBNF Management Plan, a Significant Bat Cave Prescription Area: "...includes significant bat caves and a ¼-mile radius around each opening. A significant bat cave contains a minimum of 50 Indiana bats (hibernacula) or 5 Virginia or Rafinesque's big-eared bats (maternity site or hibernacula). Such sites are found in a naturally occurring cavity or system of interconnected passages, or a tunnel or mine, located beneath the surface or within a cliff, ledge, or rockshelter. These sites occur in both limestone and sandstone."

Significant Bat Cave Prescription Areas are:
"...managed to restore or maintain the integrity of significant bat caves, cave openings, and associated underground physical, geological, hydrological, and biological features. These areas remain relatively undisturbed by management activities, except for those designed to protect or maintain endangered, threatened, and Forest Service-Sensitive species or habitat for Conservation species. Microclimate conditions, primarily temperature and humidity associated with these landscape features, persist. In addition, protection is provided for heritage resources, which are often associated with these features."

Although two previously identified Significant Bat Cave Prescription Area occur within about two miles of the APE, neither would be directly impacted by any of the alternatives. One cave (cave-like structure in a sandstone cliffline), identified by project biologists, does meet the criteria for the DBNF Significant Bat Cave Prescription Area. This cave, referred to as "Rafinesque Bat Cave" in this document, housed a maternity colony of Rafinesque's big-eared bats. The cave was entered after emergence on June 19, 2004 and juvenile Rafinesque's big-eared bats were observed on the roof of the cave. The number of juveniles was estimated at 65, although the bats were too high for an accurate count. The potential exists for this cave to house hibernating bats in winter; however, this cave was identified too late to confirm its use as a hibernacula for inclusion in this report. If alternative I is selected, this cave should be searched between January 1 and February 15 for hibernating bats by a qualified biologist to determine the impact to listed bat species. Conversations with John Omer, biologist for the DBNF London Ranger District, indicated that this cave is considered a Significant Bat Cave by the DBNF as of February 24, 2005. Forest Service GIS files for the prescription area surrounding this cave are not yet available; therefore, impacts to this resource are not discussed in terms of acreage.

5.2.41 Mitigation Measures in the DBNF

Mitigation plans for impacts to the DBNF will be coordinated with the USFS and will include general construction mitigation strategies as well as those resource specific mitigation strategies included in this chapter. Mitigation efforts may include:

- General Construction Mitigation
- Vegetation Removal Mitigation
- Erosion Control (see Chapter 5.2.30)
- Waterway and Riparian Vegetation Mitigation (see Chapter 5.2.30 *Physical Distrubance*)
- Resource Specific Mitigation Efforts (including wetlands and Threatened and Endangered Species)

General Construction Mitigation

Construction activities, associated with the proposed action, would have temporary impacts to ambient noise levels, water quality, air quality, and terrestrial habitat in the immediate vicinity of the project.

Water quality impacts through erosion and sedimentation will be temporary and controlled through the use of Best Management Practices (BMP). All appropriate permits for construction-related impacts will be required.

Table 5.2.40-5 - Impacts to Old Growth, Habitat Diversity and Riparian Prescription Areas, within the DBNF per Alternative (in acres)

Pulaski County Alternative	Old Growth	Alternative Ranking	Habitat Diversity	Alternative Ranking	Riparian	Alternative Ranking
K	0	N/A	5.17	3	112.75	5
KY80-Shifted	0	N/A	5.16	2	103.62	3
KY80-Modified	0	N/A	4.40	1	112.63	4
B	0	N/A	6.95	4	93.51	2
D	0	N/A	12.91	5	24.45	1
B-D	0	N/A	12.91	5	24.45	1
Laurel County Alternative	**Old Growth**	**Alternative Ranking**	**Habitat Diversity**	**Alternative Ranking**	**Riparian**	**Alternative Ranking**
G	0	1	112.40	2	134.08	2
H	30.606	2	98.46	1	142.50	3
I	33.449	3	198.72	3	155.62	4
L	0	1	112.40	2	123.99	1
M	0	1	112.40	2	134.08	2

Air pollution, associated with the creation of airborne particles, will be effectively controlled by watering or by the application of calcium chloride and through the use of BMP.

Sequence of construction and traffic maintenance will be planned and scheduled to minimize traffic delays throughout the project. Signs will be utilized, where appropriate, to provide notice of road closures to the traveling public. Local news media will be notified in advance of construction-related activities that could excessively inconvenience motorists. Access to all property will be maintained to the greatest extent practicable.

The removal of debris and structures will take place, in accordance with local and state regulation agencies permitting this operation. The contractor will be held responsible for methods of controlling pollution in borrow pits, other material pits, and areas used for disposal of waste materials from the project. Temporary erosion control features would include temporary seeding, sodding, mulching, sandbagging, slope drains, sediment basins and checks, artificial coverings and berms. The construction impacts may be mitigated using the following methods: keep proposed grades near existing pavement elevations so that traffic can be easily maintained; develop and maintain traffic plan during construction; develop construction sequence prior to construction; employ all practicable methods of silt, erosion, noise and emission controls, and provide for fueling and concrete washout areas with specific measures to contain pollutants.

Vegetation Removal Mitigation Efforts

The removal of existing vegetation will be limited to only that which is necessary within the project limits. The principles of context-sensitive design will be incorporated into the final design of the project to enhance that effort. Blending the roadway into the natural or existing landscape will minimize the ROW area required for construction.

Trees requiring special attention identified during the environmental phase or in the design phase that fall within the ROW, but outside the construction limits will be delineated by fencing or other measures to minimize impacts. Native hardwood trees will be planted along the ROW to replace trees removed during construction where practicable. Additional selected areas may be included based on final design requirements in accordance with requirements of the KYTC. A suggested seeding mix and tree species for planting along channel and riparian areas is given in the Ecology Baseline report.

5.2.42 Impacts to Other Significant Ecological Resources

Short Creek Karst Drainage System

Although the above ground perennial portion of Short Creek stretches less than 200 feet, it drains a large area and contains one of the most diverse karst systems in the United States (see figure 5.2.42-1). The total Short Creek basin is 21,638.7 acres and extends over nine miles from the basin's effluence into Buck Creek. It is crossed by all of the proposed build alternatives in Pulaski County. Features of the Short Creek drainage system include Sinking Valley Karst System, Short Creek (surface section), Price Valley, Bolger Mouth Cave, the Boiling Pots, and Quarry Sink. The most outstanding feature of the Short Creek drainage system is Sinking Valley which comprises the major portion of the basin. The main stream passage of Sinking Valley extends directly beneath all the Pulaski County alternatives, with the exception of Alternative D which has no impact to Sinking Valley. Karst biodiversity within this system is high, including many G1 and G2 species. Alternatives KY80-Modified, KY80-Shifted and K have a greater number of developed karst features within their proposed Rights-of-way than the other Pulaski County alternatives. Alternatives B and B-D impact this resource slightly less than the KY80 alternatives. Alternative D, by missing impacts to the main trunk of the Short Creek Basin (Sinking Valley), and instead crossing a much less developed karst branch of the basin (Burdine Valley) has the least impacts to this Outstanding Ecological Resource. See Section 4.2.9 (Geology, Hydrology and Geohazards), 4.2.3-5 (Local Karst Hydrogeologic Setting) and Section 4.2.10 (Karst Fauna) for further discussion on the Short Creek drainage system. See Section 5.2.6-22 for general karst impacts per alternative.

Cedar Creek Karst Drainage System

Cedar Creek is a small tributary of Buck Creek lying in the southern portion of the project area west of Buck Creek. Cedar Creek has several karst features in its basin which encompasses 756.1 acres. Several sink holes and Stykes Cave occur in the headwaters approximately 1.3 miles in a direct line upstream from the Alternative D impact. Stykes Cave is home to a number of globally rare species as well as common cave fauna like the little brown bats pictured (figure 5.2.42-2). Stykes Cave tied for the second highest composite community rarity score of all caves sampled during the I-66 Karst Faunal Survey. Downstream of Stykes Cave, Cedar Creek has an above ground portion which terminates in the mouth of Cedar Creek Cave approximately 470 feet downstream from the Alternative D impact. Cedar Creek Cave resurges just above Buck Creek at Cedar Creek Spring Cave. Many globally significant, rare, and G1 and G2 species occur within this cave system. The KSNPC threatened Packard's southern cave crayfish, (Orconectes australis packardi) was identified here during the karst surveys conducted for this project. This cave system is particularly of note, as it lies adjacent to a possible interchange. Impacts to this system would occur only from Alternative D. See Section 4.2.10 (Karst Fauna) for further discussion on the Cedar Creek Cave System. See Section 5.2.6-22 for general karst impacts per alternative.

Pine Creek Gorge (Figure 5.2.42-3)

Pine Creek is a stream corridor considered significant by the KSNPC and USFS. Within the project corridor, it changes from a first order stream near its headwaters, to a third order stream where it flows under KY 80. Areas of old growth trees are known to grow along the corridor. An Appalachian Mesophytic Forest Natural Area (KSNPC) occurs in the Pine Creek drainage. This gorge is a rugged area of large multi-level clifflines, rockshelters, and crevices that are potential habitat for rare species. KSNPC recognizes the Pine Creek Gorge, surrounding the KY 80 crossing of Pine Creek and continuing upstream to the Rockcastle River, as a significant area because of extensive, relatively undisturbed ravine forests, with several rare species. Many of the trees occurring within this forested area have an average age of one hundred years or more. KSNPC has recommended this area to the USFS as a natural area for protection. The Laurel County alternative with the greatest impact to this resource is Alternative I which crosses south of existing

Figure 5.2.42-1 – Merged Picture of Short Creek Surface Reach

Figure 5.2.42-2 – Little Brown Bats Hibernating in Stykes Cave in the Cedar Creek Drainage Basin

Figure 5.2.42-3 – Pine Creek Gorge North of KY80

KY 80 along a new alignment, and would require, as designed, placing fill material with 14.77 acre footprint into pristine hemlock forest. All other build alternatives intersect the area delineated by KSNPC as Appalachian Mesophytic Forest; however, they cross Pine Creek Gorge largely on top of the existing KY 80 fill area, which is substantially stripped of native vegetation. Outside the KY 80 fill disturbance, the Rights-of-Way of alternatives G, H, L, and M intersect 3.13 acres of what project biologists consider true Appalachian Mesophytic Forest. None of the Pulaski County alternatives impact this resource.

5.2.43 Short Creek, Cedar Creek and Pine Creek Gorge Mitigation

Short Creek and Cedar Creek Karst Drainages Impact Minimization and Mitigation

Mitigation efforts outlined in this chapter for karst features will be employed in the Short Creek and Cedar Creek karst drainage areas (see section 5.2.10).

Pine Creek Gorge Impact Minimization and Mitigation

This area should be avoided if possible. Mitigation is not feasible for an old growth forest within the immediate surrounding area. Should the gorge be filled, old growth trees would be destroyed, along with the ecosystem that supports them. In the event that the gorge cannot be avoided, bridging the span should be considered, and any mitigation, avoidance or compensation measures from this chapter that would apply will be followed. In the event that bridging is not chosen as an avoidance measure, the surface area of fill will be reduced by constructing steeper fill cuts, and less highway grade, if possible. See Section 4.8.4 of the Terrestrial an Aquatic Baseline Report (KSNPC Monitored Floristic Community Types) for further discussion of the Appalachian Mesophytic Forest.

5.2.44 Terrestrial Ecosystems Impacts

One of the impacts of highways on an ecosystem is the formation of barriers between existing ecological communities. These barriers can cause impacts on wildlife populations that have requirements for areas on both sides of a facility. Loss of range necessary for feeding or territorial behaviors may reduce the vitality of animal populations by decreasing diversity and abundance of food sources and disrupting nesting or other reproductive activities. Transportation barriers may also cause increases in mortality rates for animals attempting to cross to another portion of their fragmented range. Migrating or moving wildlife can also cause safety hazards to vehicles and motorists.

Construction of the roadway will initially eliminate all flora within the construction limits. Construction of the proposed project will cause a loss of habitat within the construction zone, and a long-term net loss of biomass. Alteration of terrestrial vegetation may affect wildlife populations. Species tolerant to grassland areas will replace species currently inhabiting fields and forested areas, leading to a decrease in species diversity. Construction within forested areas creates loss and fragmentation of habitat that is difficult to mitigate. Placement of spoil material will alter habitat and displace wildlife.

Wildlife habitats may be fragmented with construction of the proposed project, which disrupts wildlife travel corridors, and foraging and breeding habitats. Fragmentation of habitat reduces species gene pools, leading to a loss in genetic variability, reducing species adaptability and health, and increasing the likelihood for extirpation or extinction. Many migratory birds need large areas of non-fragmented forests in which to safely nest and rear young. Although bird species diversity is often higher along the edges forests, these areas often act as a sink (i.e., while birds may be attracted to these areas for foraging, they experience low breeding success rates due to higher nest parasitism by brown-headed cowbirds and predation), (Buehler and Miles 1996).

See Section 5.2.48 (Federal/KSNPC Listed, DBNF Sensitive Species, and Globally Listed Species) for impacts to KSNPC and federally listed species of terrestrial flora and fauna. See Section 5.2.45 (KSNPC Monitored Floristic Community Types) for discussion regarding the Appalachian Mesophytic Forest impacts.

5.2.45 Habitat Types Within the Project Area

The following are the habitat types within the I-66 Somerset to London Project Area (descriptions follow):

- Residential/Mowed Grass
- Cropland and Pasture
- Old Field Herbaceous
- Shrublands
- Mixed Rangeland
- Red Cedar/Oak Forest
- Pine/Oak Forest
- Calcareous Oak Forest
- Noncalcareous Oak Forest
- Forest by Watercourse
- Hemlock Forest
- Sugar Maple/Hemlock/White Cedar
- Rock/Gravel/Sand Bar
- Major Watercourse
- Commercial
- Major Roadway

The alternatives that have the most/least impact on each type is given below (for a complete summary of impacts see table 5.2.44-1 in appendix C):

<u>Residential/Mowed Grass</u>
The Pulaski County alternative with the greatest impacts to this habitat type is KY80-Modified (125.59 acres), while the alternative with the least amount of impacts is Alternative D (7.26 acres). Alternative G in Laurel County has the greatest impacts to Residential/mowed Grass (110.98 acres), while Alternative I has the least amount (36.33 acres).

<u>Cropland and Pasture</u>
Pulaski County Alternative K has the greatest amount of impacts to cropland and pasture habitats at 239 acres, while Alternative KY80-Shifted has the least impacts with 190.67 acres. In Laurel County, Alternative L, with 403.13 acres of impacts, has the greatest amount of impacts, and Alternative I, with 276.66 acres of impacts, has the least amount of impacts to this habitat type.

<u>Old Field Herbaceous</u>
The Pulaski County alternative with the greatest amount of impacts to Old Field Herbaceous is Alternative KY80-Modified (166.49 acres), while the alternative with the least amount of impacts to this habitat type in Pulaski County is Alternative D (15.97 acres). Alternatives G and M in Laurel County both have the greatest amount of impacts in that county with 21.95 acres, each. Alternative I has the least amount of impacts of Laurel County alternatives (7.19 acres).

<u>Shrublands</u>
Of the Pulaski County alternatives, Alternative KY80-Modified has the greatest amount of impacts to this habitat type (66.67 acres), while Pulaski County Alternative B has the least amount of impacts to Shrublands (36.87 acres). In Laurel County, Alternative G (143.84 acres) has the greatest amount of impacts to this habitat type, while Alternative I (50.22 acres) has the least amount of impacts.

<u>Mixed Rangeland</u>
The greatest amount of impacts to Mixed Rangeland among Pulaski County alternatives is Alternative K (27.53 acres), while Alternative D has no impacts to this habitat type. Alternative H (26.95 acres) in Laurel County has the greatest amount of impacts, while alternatives G, L, and M each have no impacts to Mixed Rangeland.

<u>Red Cedar/Oak Forest</u>
The Pulaski County alternative with the greatest amount of impacts to this habitat type is Alternative KY80-Shifted (132.54 acres), while Alternative B has the least amount of impacts (90.55 acres). There are no impacts to Red Cedar/Oak Forest habitat from any of the Laurel County alternatives.

<u>Pine/Oak Forest</u>
Among Pulaski County alternatives, the one with the greatest amount of impacts to this habitat type is Alternative D (106.68 acres), while the alternative with the least amount of impacts is Alternative KY80-Shifted (37.04 acres). In Laurel County, Alternative M has the greatest amount of impacts, while Alternative I has the least amount (59.61 acres).

<u>Calcareous Oak Forest</u>
Alternative KY80-Modified has the greatest amount of impacts to Calcareous Oak Forest habitat in Pulaski County, while Alternative K has the least amount (109.98 acres). No Laurel County alternatives have any impacts to this habitat type as the soil type in that county is primarily noncalcareous.

<u>Noncalcareous Oak Forest</u>
The Pulaski County alternative with the greatest impacts to this habitat type is Alternative D (217.67 acres), while Alternative B-D has the least amount of impacts (154.36 acres). In Laurel County, Alternative I has the greatest amount of impacts to Noncalcareous Oak Forest habitat (290.30 acres), while Alternative M has the least amount of impacts to this habitat type (178.07 acres).

<u>Forest by Watercourse</u>
The Pulaski County alternative with the greatest amount of impacts to Forest by Watercourse habitat is

Alternative KY80-Modified (21.88 acres), while Alternative B has the least amount of impacts to this habitat (1.43 acres). Among the Laurel County alternatives, Alternative H, with 40.20 acres of impacts, has the greatest amount of impacts to this habitat type, while Alternative G, with 17.47 acres, has the least amount.

Hemlock Forest
No impacts to Hemlock Forest habitat occur along any of the Pulaski County alternatives, because hemlock forests are sparse in that county. In Laurel County, where hemlocks are more prevalent, Alternative I has 189.41 acres of impacts (the greatest amount), while Alternative L has 33.29 acres (the least amount) of impacts.

Sugar Maple/Hemlock/White Cedar
Among the Pulaski County alternatives, Alternative D has the greatest amount of impacts to this habitat type (2.92 acres), while Alternatives KY80-Shifted has no impacts. In Laurel County, no impacts to this habitat type occur from any of the alternatives.

Rock/Gravel/Sand Bar
No impacts occur to this habitat from the Pulaski County alternatives, while all Laurel County alternatives have the same amount of impacts (0.08 acres). This is due to the convergence of all alternatives at the Rockcastle River where this habitat type occurs. For the purposes of this document, the Pulaski County Alterative end at the western edge of the Rockcastle River. All impacts to the river itself are attributed to the Laurel County alternatives.

Major Watercourse
Among Pulaski County alternatives, Alternative D has the greatest amount of impacts to this habitat type, while alternatives B and B-D each have the least amount of impacts (0.30 acres). Alternative H in Laurel County has the greatest amount of impacts to this habitat type (0.66 acres), while Alternatives G and M both have the least amount of impacts (0.40 acres, each).

Commercial
Alternatives B and B-D have the greatest amount of impacts to Commercial habitat (38.13 acres, each) in Pulaski County, while Alternative D has no impacts to Commercial habitat. Among Laurel County alternatives, alternatives L and M each have the least amount of impacts to this habitat type (17.01 acres), while Alternative H has the least amount of impacts (1.70 acres).

Major Roadway
The Pulaski County alternative with the greatest amount of impacts to Major Roadway habitat is Alternative KY80-Modified (123.30 acres), while the least impacts to major roadways is Alternative K (10.73 acres). In Laurel County, Alternative G has the greatest amount of impacts to this habitat type (77.92 acres), while Alternative I, with 40 acres of impacts, has the least amount.

KSNPC Monitored Floristic Community Types

Two KSNPC monitored floristic community types, the Appalachian Mesophytic Forest and the Hemlock Mixed Forest, occur within the project area. Of these, only portions of the Appalachian Mesophytic Forest would be directly impacted by any of the alternatives. All Laurel County alternatives have equal impacts to this community type (15 acres), with the exception of Alternative I, which has no impacts. None of the Pulaski County alternatives impacts this community type. For more information on Appalachian Mesophytic Forest see the Terrestrial and Aquatic (Ecology) Baseline Report.

5.2.46 Fragmentation of Forested Habitat

Fragmentation of forested habitat is a major threat to biological diversity and the survival of many species worldwide. Fragmentation produces what biologists refer to as "edge" habitat, which is the junction at which two or more different types of habitat meet. Edge habitat makes nesting neoptropical bird species vulnerable to predation by opportunistic and adaptable animals, such as raccoon, opossum, skunk, fox, rat snakes, grackles, crows, blue jays, and feral and pet cats and dogs. Brown-headed cowbirds proliferate in edge habitat because it facilitates their ability to parasitize bird nests. Aggressive native and nonnative birds outcompete less aggressive native birds for nesting sites in edge habitat.

Fragmentation reduces contiguous habitat and isolates wildlife habitat. This has the effect of limiting wildlife gene pools by impeding new gene sources, which limits genetic variability. Less genetic variability leaves wildlife populations more vulnerable to disease and less adaptable to changes in their environment. Fragmentation of habitat also leads to an increase in exotic invasive plant species by creating conditions favorable for them (i.e., open disturbed areas). Exotic invasive species inhibit the growth of native plants through aggressive competition. Because natural controls for these species do not occur in their nonnative habitat, exotic invasive plants exhibit rampant, unconstrained growth, while producing less nutritious food sources and limiting wildlife food variability.

For the purposes of this report, the impact to contiguous forested habitat is represented by a linear distance of forested habitat that would be taken by the alternative cutting through a contiguous forested area greater than 100 hectares (247.12 acres). A 100-hectare patch, considered to be the absolute minimum guideline for forest patch size, was determined to protect about 60% of the highly-sensitive regional forest bird species population in Illinois forests (Eastern Ontario Model Forest 2004). Forested riparian areas were considered in determining impacts to this habitat even if they were less than 100 hectares in area because of their benefits as wildlife corridors. These smaller forested riparian habitats link larger contiguous areas together, thereby reducing the detrimental effects of fragmentation.

The Pulaski County alternative with the greatest amount of fragmentation impact to contiguous forested habitat is Alternative D (28,488 linear feet), while both KY80-Modified and KY80-Shifted each have no fragmentation impacts to contiguous forested habitat. Alternatives K and B both have 2,553 linear feet of impact, while Alternative B-D has 2,857 linear feet of impacts. Although, Alternative B-D has more new habitat fragmentation impacts than do alternatives K and KY80-Shifted, and Alternative B has new impacts equal to those of Alternative K, it should be noted that the impacts created by Alternatives B and B-D would result in an increase of existing habitat fragmentation along KY80, while Alternative D would create new habitat fragmentation. The increase of existing fragmentation occurs due to the orientation of alternatives B and B-D parallel to KY80, but largely outside the existing fragmentation. Conversely, KY80-Shifted, KY80-Modified and K essentially follow the existing KY80 ROW through most of Pulaski County.

The Laurel County alternative with the greatest amount of impact to contiguous forested habitat is Alternative I (26,755 linear feet), while Alternative G has the least amount of impacts (8,108 linear feet). Alternative L has 8,313 linear feet of impact; Alternative M has 12,493 linear feet of impact; Alternative H has 26,755 linear feet of impact. For a complete impact summary on Forest Fragmentation see the composite impact table 3.2.5-2 for ecological resources in Chapter 3.

5.2.47 Habitat Impact Minimization and Mitigation

Best Management Practices will be employed to Avoid, Minimize and Mitigate impacts to wildlife habitat. See mitigation measures for federally protected bat species and compensatory mitigation pertaining to the Migratory Bird Treaty Act for specific discussions of minimization and/or mitigation of these habitat types.

Faunal (Wildlife) Impacts

5.2.48 State and Federally Listed Species

Impacts from the Project on Federally Listed Species Identified within the Project Area

Ten federally listed species were identified from the project area during field surveys for this project. They are as follows:

- the northern white cedar (Thuja occidentalis)
- white walnut (Juglans cinerea)
- Tennessee clubshell (Pleurobema oviforme)
- fluted kidneyshell (Ptychobranchus subtentum)
- Cumberlandian combshell (Epioblasma brevidens)
- ashy darter (Etheostoma cinereum)
- bald eagle (Haliaeetus leucocephalus)
- Rafinesque's big-eared bat (Corynorhinus rafinesquii)
- the gray bat (Myotis grisescens)
- the small-footed bat (Myotis leibii)

The following is a description of ***each of the federally listed species*** identified in the project, including alterative impacts on the species and/or its habitat:

Northern white cedar (Thuja occidentalis) – Federal Species of Management Concern, KSNPC Threatened

The northern white cedar was identified from the project area, exclusively in Pulaski County along Buck Creek. Its habitat in Kentucky is along rocky open or wooded riverbanks, usually on limestone (KSNPC correspondence 2004). Northern white cedar occurred in all areas within the project alternatives identified as potential habitat. This species is classified by the KSNPC as "sensitive element;" therefore, known locations, other than those identified during field surveys for this project, will not appear on project mapping. Alternatives K, KY 80 Modified, B, D and B-D all have direct impacts to this species (see Table 5.2.48-1 for direct impacts). The Pulaski County alternative with the greatest impacts is Alternative D with 2.9 acres of impact, while KY 80 Shifted has no impact to potential habitat for this species. No Laurel County alternative impacts this species.

White walnut (Juglans cinerea) – Federal Species of Management Concern, KSNPC Special Concern, DBNF Sensitive

White walnut or butternut was identified in two locations within the project area, most notably in Laurel County, where it occurred along Sinking Creek. Alternative G will impact white walnut trees identified during project surveys along Powdermill Creek. Alternative H and I both come within 800 feet of impacting another white walnut tree identified during project surveys (see Table 5.2.48-1 for direct impacts). The Laurel County alternative with the greatest impact to the potential habitat of this species is Alternative I with 197.4 acres of impact, while the alternative with the least amount of impact is Alternative G with 97.4 acres of impact. The greatest impact from Pulaski County alternatives would occur from Alternative B (37.5 acres), while the alternative with the least impacts is Alternative B-D (19.9 acres). Laurel County alternatives G and M would each have one direct impact to this species, in which one or more individuals would be eliminated.

Tennessee clubshell (Pleurobema oviforme) – Federal Species of Management Concern, KSNPC Endangered, DBNF Sensitive

The Tennessee clubshell was identified during mussel surveys conducted for this project. A single very weathered shell was collected from Buck Creek. It inhabits small headwater streams and large rivers with sand/gravel and, occasionally mud substrates (KSNPC coordination 2004). The Pulaski County alternative with the greatest amount of impact to Tennessee clubshell potential habitat is Alternative D (0.88 acres), while the alternatives K and KY80-Modified have the least impacts (0.18 acres, each). Among Laurel County alternatives, Alternative H has the greatest impact (0.73 acres), while alternatives G and M have the least (0.63 acres, each). See discussion on freshwater mussel impacts for more information on the Tennessee clubshell impacts and potential habitat.

Fluted kidneyshell (Ptychobranchus subtentum) – Federal Species of Concern, KSNPC Endangered, DBNF Sensitive

This species was identified along all Pulaski County alternatives during mussel surveys of Buck Creek in Pulaski County and the Rockcastle River in Laurel County. Its habitat is "smaller streams and rivers where it occupies clean swept rubble, gravel and sand substrates in shallow riffles and shoals with moderate to swift current" (KSNPC correspondence 2004). The Pulaski County alternative with the greatest amount of impact to the potential habitat of fluted kidneyshell is Alternative D (0.88 acres), which also has one direct impact to this species. Alternatives K and KY80-Modified have the least impacts (0.18 acres, each); however, both of these alternatives have two direct impacts, each to the fluted kidneyshell. Alternatives KY80-Shifted, B and B-D each have one direct impact to this species (see Table 5.2.48-1 for direct impacts). Among Laurel County alternatives, Alternative H has the greatest impact to the habitat of the fluted kidneyshell, while alternatives G and M have the least impact with 0.63 acres, each. See discussion on freshwater mussel impacts for more information on the Tennessee clubshell impacts and potential habitat.

Ashy darter (Etheostoma cinereum) – Federal Species of Management Concern, KSNPC Special Concern, DBNF Sensitive

The ashy darter was identified during aquatic surveys of the Rockcastle River conducted for this project. Its habitat is medium-sized rivers with slow to moderate current, usually associated with cover, such as boulders, snags, and detritus. Historical records indicate that it occurs in Buck Creek in Pulaski County and the Rockcastle River along the Pulaski/Laurel County line (KSNPC correspondence 2004). The Pulaski County alternative with the greatest amount of impacts to ashy darter potential habitat is Alternative D (1.8 acres), while the alternatives with the least amount are alternatives B and B-D (0.4 acres, each). Each Laurel County alternative has an equal amount of impacts to the potential habitat of the ashy darter (0.5 acres), and each has one direct impact to this species (see Table 5.2.48-1 for direct impacts).

Bald eagle (Haliaeetus leucocephalus) – Federally Threatened, Kentucky Threatened

The bald eagle was not identified by HMB biologists during field surveys for this project. It is known to nest at Laurel River Lake in Laurel County, and forage along the Cumberland River to Lake Cumberland (Personal communication with John Omer, USFS biologist, spring 2004). All Pulaski County alternatives have equal impacts to the potential habitat of the bald eagle (0.5 acres), while all Laurel County alternatives have equal impacts (2.9 acres).

Rafinesque's big-eared bat (Corynorhinus rafinesquii) – Federal Species of Management Concern; KSNPC Special Concern, DBNF Sensitive

The Rafinesque's big-eared bat was identified during bat surveys conducted for this project. During winter in Kentucky, the Rafinesque's big-eared bat hibernates in caves, abandoned mines and wells. During summer, it roosts in unoccupied buildings, barns, large tree hollows, rock shelters, and cave entrances (Bat Conservation International, Inc. 2001). All build alternatives in both counties will impact locations where this species is known to occur. In Pulaski County, the alternatives which will have the greatest impact to this species are Alternatives K, B, B-D and KY80- Modified which all impact Stab Cave, and Alternative D which impacts Cedar Creek Cave. Single Rafinesque's big-eared bats were documented hibernating in both of these caves and both caves were used by this species for night roosting. KY80-Shifted has the least impact to documented occurrence sites within Pulaski County. Impacts to potential Rafinesque's big-eared bat habitat within Pulaski County are similar and range from 19.07 acres (KY80-Shifted) to 22.93 acres (Alternatives D and B-D). In Laurel County, the alternative with the greatest impact to the Rafinesque's big-eared bat is Alternative I, which will impact a large maternity colony for this species identified during project surveys. All Laurel County alternatives are located within close proximity to capture locations for the Rafinesque's big-eared bat and their presence is assumed along all build alternatives. Impacts to potential habitat for this species from the Laurel County Alternatives range from 47.12 acres (Alternative H) to 86.531 acres (Alternative I).

Gray bat (Myotis grisescens) – Federally Endangered, KSNPC Threatened

The gray bat was identified from several sites within the proposed project area. All alternatives within Pulaski County will impact known foraging locations of this species as gray bats from Blowing Cave were shown to use Buck Creek and Flat Lick Creek throughout their lengths. In Laurel County the gray bat was identified in close proximity to Alternative I in the Little Laurel River at Ward Branch and away from alternatives still

under consideration on Sinking Creek west of the Sinking Creek Road crossing. Summer habitat for this species is abundant within the project corridor. The Pulaski County alternative with the greatest impact to the potential gray bat habitat is Alternative KY80-Modified (250.82 acres), which also has four direct impacts to this species. Alternative I would have the greatest impact to potential gray bat habitat of all Laurel County alternatives (100.33 acres); therefore, the alternative combination with the greatest impacts to potential habitat for this species is KY80-Modified-I (351.15 acres, combined). The Pulaski County alternative with the least impacts to gray bat potential habitat is Alternative B-D (50.95 acres), which has three direct impacts to this species. Pulaski County alternatives K and B each have three direct impacts to the gray bat; while KY80-Shifted and D each have four direct impacts to this species (see Table 5.2.48-1 for direct impacts). The Laurel County alternative with the least impact is Alternative L (43.82 acres); thus, the alternative combination with the least amount of impacts to potential gray bat habitat is B-D-L, with a total of 94.77 acres of impact.

Small-footed bat (Myotis leibii) – Federal Species of Management Concern, KSNPC Threatened, DBNF Sensitive

This species was identified during bat surveys conducted for this project. The eastern small-footed bat inhabits a variety of habitats, including caves, mines, protected areas along clifflines, abandoned buildings, and under rocks on the ground or on the floor of caves (KSNPC correspondence 2004). They are also known to use bridges for both daytime and night roosting and have been documented using bridges as maternity colonies near the project area. Project surveys identified the small-footed bat from both Pulaski and Laurel counties, though occurrences were focused around the Rockcastle River at KY 80. Small-footed bats were found using the KY 80 Bridge over the Rockcastle River as a night roost on numerous occasions. On two occasions small-footed bats were observed with non-volant juveniles under the bridge though they were never located there when the bridge was checked during the day. As documented small-footed bat activity in the project area was centered on the KY 80 Bridge over the Rockcastle River and all alternatives will have a nearly identical impact to this resource, all build alternatives will have the same impact to documented small-footed bat locations (see Table 5.2.48-1 for direct impacts). Impacts to potential habitat for this species are very similar for all Pulaski County alternatives and range from 19.3 acres (Alternative K) to 18.6 acres (KY 80-Modified). Laurel County alternatives range from an impact of 47.1 acres (Alternative H) to 86.5 acres (Alternative I).

Direct Impacts to Federally Listed Species

Table 5.2.49-1 lists the number of direct impacts to each federally listed species identified from the project area (**i.e., the number of times the alternative crosses the area in which the species was located**) per alternative. The bald eagle was not identified within the project area by project biologists, and was did not occur within typical bald eagle habitat; therefore, this species is not included as a direct impact in the table. Impacts to mussel species and the ashy darter are difficult to predict since the streams will be clear-spanned. Impacts to bat species are difficult to quantify, although there is evidence to indicate that these bat species exhibit strong site fidelity (Mitchell and Martin 2002, Trousdale and Beckett 2001, 2002, USFWS 1982).

Table 5.2.49-1 Direct Impacts (Number of Times Alternative Crosses Species Location) to Federally Listed Species per Alternative Identified from the I-66 Somerset to London Project Area

		Pulaski County						Laurel County				
Species	**Federal Listing**	**K**	**KY80-Shifted**	**KY80-Modified**	**B**	**D**	**B-D**	**G**	**H**	**I**	**L**	**M**
Flora												
northern white cedar (*Thuja occidentalis*)	Species of Management Concern (KSNPC Threatened)	1		1	1	1	1					
butternut (*Juglans cinerea*)	Species of Management Concern (KSNPC Special Concern; DBNF-S)							1				1
Freshwater Mussels												
Cumberlandian combshell (*Epioblasma brevidens*)	Endangered (KSNPC Endangered)					1						
Fluted kidneyshell (*Ptychobranchus subtentum*)	Candidate (for listing) (KSNPC Endangered; DBNF-S)	2	1	2	1	1	1					
Fish												
ashy darter (*Etheostoma cinereum*)	Species of Management Concern; (KSNPC Special Concern; DBNF-S)							1	1	1	1	1
Mammals												
Rafinesque's big-eared bat (*Corynorhinus rafinesquii*)	Species of Management Concern (KSNPC Special Concern; DBNF-S)	4	5	5	5	4	5	1	1	2	1	1
gray bat (*Myotis grisescens*)	Endangered (KSNPC Threatened)	3	4	4	3	4	3					
small-footed bat (*Myotis leibii*)	Species of Management Concern (KSNPC Threatened; DBNF-S)	1	1	1	1	1	1	1	1	1	1	1
Total Impacts per Alignment		11	11	13	11	12	11	4	3	4	3	4

It is likely that individual bats would suffer stress due to the loss of their known habitats. Additionally, they may not find suitable habitat with an appropriate carrying capacity [(i.e., the size of a population that can live indefinitely in an environment without doing that environment harm) (World Builders 2004)]. It is possible that alternative appropriate habitats may not be available in the immediate area.

5.2.49 Federally Listed Species in the Project Area *Not* Identified

Federally listed species, discussed in section 4.2.12, that were not identified in the project are discussed in terms of potential indirect effects from habitat loss, with the alternatives with the greatest and least impacts given.

White-fringeless orchid (Platanthera integrilabia) – Federal Candidate, KSNPC Endangered, DBNF Sensitive

The white-fringeless orchid was not identified from field surveys conducted for this project; however its habitat, partial shade or open seepage in wooded or herbaceous areas such as swamps, floodplain forests, and seepage slopes occurs within the project area (KSNPC correspondence 2004). This species is classified by the KSNPC as "sensitive element;" therefore, its known locations will not appear on project mapping. The Laurel County alternative with the greatest amount of impacts is Alternative H (11.33 acres), while alternatives G, L and M all have the least amount of impacts (3.41 acres, each). No impacts to this species occur on any of the Pulaski County alternatives due to lack of habitat.

Rockcastle Aster (Eurybia saxicastelli) – Federal Species of Management Concern, KSNPC Threatened

The Rockcastle aster was not identified during field surveys for this project; however potential habitat for this species, "thickets in transition from open boulder-cobble bars to adjacent slope forest," (KSNPC correspondence 2004) occurs at the only location in which an alternative is permitted (i.e., at the KY 80 crossing), and it is known from areas along the Rockcastle River in Laurel County (KSNPC correspondence 2004). Because this species was not located along any of the alternatives, no direct impacts to this species would occur from any of the proposed alternatives; however, its potential habitat would be impacted. Potential habitat for this species is impacted equally at each of the Laurel County alternatives (0.1 acres, each).

Virginia spiraea (Spiraea virginiana) – Federally Threatened, KSNPC Threatened

Virginia spiraea was not identified during field surveys for this project. Very little suitable habitat for Virginia spiraea occurs within the project area, with the exception of a sand and gravel bar across the Rockcastle River at the only location in which an alternative is permitted (i.e., at the KY 80 crossing), and a cobble bar located approximately 100 feet downstream of the Alternative G crossing across Sinking Creek. Because this species was not located along any of the alternatives, no direct impacts to this species would occur on any of the proposed alternatives; however, the extant sand and gravel bar is marginal to poor potential habitat for Virginia spiraea. All Laurel County alternatives have equal impacts to Virginia spiraea potential habitat (0.1 acres, each). None of the Pulaski County alternatives would have impacts to the habitat of Virginia spiraea.

Shortspire hornsnail (Pleurocera curta) – Federal Species of Management Concern, KSNPC Special Concern, DBNF Sensitive

Shortspire hornsnail was not identified from stream surveys conducted for this project, and it is not known historically from the project area. Habitat for this species has not been well documented. Because this species is not known from the project area, impacts to this species would likely not occur; therefore, impacts to its habitat were not calculated.

Cumberland papershell (Anodontoides denigratus) – Federal Species of Management Concern, KSNPC Endangered, DBNF Sensitive

This species was not identified during mussel surveys conducted for this project. It is known from lower Sinking Creek in Laurel County in silt, mud or sand substrates (KSNPC coordination 2004). The Laurel County alternative with the greatest amount of impacts to Cumberland papershell potential habitat is Alternative L (0.23 acres), while alternative G and M each have no impact.

Cumberland elktoe (Alasmidonta atropurpurea) – Federally Endangered, KSNPC Endangered

Cumberland elktoe was not identified from surveys conducted along the proposed alternatives. This species is known to occur downstream of Alternate I across Sinking Creek in an area that is designated Critical Habitat by the USFWS. Although the Cumberland elktoe was not identified from Sinking Creek within the alternative ROWs during mussel surveys for this project, perturbations occurring upstream would likely have an impact on this population. The Laurel County alternative with the greatest impact to the potential habitat of this species is Alternative L (0.23 acres), while alternatives G and M each have no impacts. In the project area, this species is known only from lower Sinking Creek; therefore, no impact to the Cumberland elktoe occurs from any Pulaski County alternative.

Cumberland bean (Villosa trabalis) – Federally Endangered, KSNPC Endangered

There are records of this species occurring in the Rockcastle River, and Sinking and Buck creeks, although no individuals of this species were identified from surveys conducted along any of the proposed alternative crossings. The Pulaski County alternative with the greatest amount of impact to the potential habitat of this species is Alternative D (0.88 acres), while alternatives K and KY80-Modified each have the least amount of impact (0.18 acres). Among Laurel County alternatives, Alternative H has the greatest impact, while alternatives G and M have the least impact with 0.63 acres, each.

Oyster mussel (Epioblasma capsaeformis) – Federally Endangered, KSNPC Endangered

This species may have been extirpated from both the Rockcastle River in Laurel County and Buck Creek in Pulaski County (KSNPC correspondence 2004). No shells or live individuals of the oyster mussel were found during mussel surveys conducted for this project. All alternatives which cross Buck Creek cross at the section designated by the USFWS as Critical Habitat for this species. The Pulaski County alternative with the greatest amount of impact to the potential habitat of oyster mussel is Alternative D (0.88 acres), while the alternatives K and KY80-Modified have the least impacts with 0.18 acres, each. Among Laurel County alternatives, Alternative H has the greatest impact, while alternatives G and M have the least impact with 0.63 acres, each.

Snuffbox (Epioblasma triquetra) – Federal Species of Management Concern, KSNPC Endangered, DBNF Sensitive

The snuffbox was not identified during mussel surveys conducted for this project. Its habitat is medium-sized streams to large rivers, generally in mud, rocky, gravel or sand substrates (KSNPC correspondence 2004). The Pulaski County alternative with the greatest amount of impact to snuffbox potential habitat is Alternative D (0.88 acres), while the alternatives K and KY80-Modified have the least impacts (0.18 acres, each). Among Laurel County alternatives, Alternative H has the greatest impact (0.73), while alternatives G and M have the least impact (0.63 acres, each).

Little-wing pearlymussel (Pegias fabula) – Federally Endangered, KSNPC Endangered

In the general project area, this species is known historically from Horse Lick Creek, Big South Fork, and Little South Fork, none of which will be impacted by this project. No shells or live individuals were found during mussel surveys conducted for this project. The Pulaski County alternative with the greatest amount of impact to the potential habitat of little-wing pearlymussel is Alternative D (0.88 acres), while the alternatives K and KY80-Modified have the least impacts with 0.18 acres, each. Among Laurel County alternatives, Alternative H has the greatest impact (0.73 acres) while alternatives G and M have the least impact with 0.63 acres, each.

Purple lilliput (Toxolasma lividus) – Federal Species of Management Concern, KSNPC Endangered, DBNF Sensitive

This species was not identified during mussel surveys conducted for this project. Its habitat is small to medium-sized streams in sand, fine gravel or mud substrates in shallow water. Historical records indicate that it occurs in Buck Creek in Pulaski County (KSNPC correspondence 2004). The Pulaski County alternative with the greatest amount of impact to purple lilliput potential habitat is Alternative D (0.52 acres), while the alternative with the least amount of impact is Alternative KY80-Shifted (0.06 acres). There are no records of the purple lilliput from Laurel County

streams; therefore, no impacts would occur along any of the Laurel County alternatives.

Blackside dace (Phoxinus cumberlandensis) – Federally Threatened, KSNPC Threatened

The blackside dace is known from the general area of the proposed project, but not from any of the streams which the alignments cross, with the exception of the Rockcastle River near its confluence with the Cumberland River. The blackside dace was not identified during stream surveys conducted for this project. Archival records indicate that this fish occurs in Craig Creek in Laurel County, at a reach that lies about four miles south of the southern-most alternative (Alternative I) (KSNPC correspondence 2004). Neither Craig Creek nor any of its tributaries would be impacted by any of the alternatives, either directly or by drainage from the roadway. Correspondence with Victoria Bishop (USFS-DBNF) indicated the recent discovery of the blackside dace in Ned's Branch also in Laurel County. Ned Branch is located near the mouth of the Rockcastle River and will not be impacted by any project alternatives. The Laurel County alternative with the greatest impacts to the potential habitat of this species is Alternative H (1.7 acres), while the alternative with the least amount of impacts is Alternative L (0.2 acres). No impacts would occur from any of the Pulaski County alternatives.

Olive darter (Percina squamata) – Federal Species of Management Concern, KSNPC Endangered, DBNF Sensitive

This species was not identified during aquatic surveys conducted for this project. The olive darter is recorded from the Rockcastle River (KSNPC correspondence 2004). Its habitat is upland streams and rivers in riffles with boulder, cobble and pebble substrates (Burr and Warren 1986). All Laurel County alternatives have an equal amount of impact to the potential habitat of this species (0.6 acres). No impacts occur from any of the Pulaski County alternatives.

Red-cockaded woodpecker (Picoides borealis) – Federally Endangered, KSNPC Extirpated

The red-cockaded woodpecker was not identified from the project area during field surveys for this project. KSNPC considers this species extirpated in Kentucky; therefore, no alternatives would impact this species.

Indiana bat (Myotis sodalis) – Federally Endangered, KSNPC Endangered

The Indiana bat was not identified from field surveys conducted for this project; however records indicate that an Indiana bat was identified from Blowing Cave in Pulaski County in November, 1991 (Personal communication with Traci Wethington November 2004), and correspondence with KSNPC indicated that they have been identified from nearby areas. The Indiana bat can use a variety of habitats, including pine-oak forests, calcareous oak forests, noncalcareous oak forests, forests by watercourses, hemlock forests, sugar maple/hemlock/white cedar forests, and major watercourses. The acreages from these habitats were used to calculate impacts to Indiana bat habitat. The Pulaski County alternative with the greatest amount of impact to Indiana bat potential habitat is Alternative D (495.5 acres), while the alternative with the least amount of impact is Alternative K (358.6 acres). Among Laurel County alternatives, Alternative I (569.7 acres) has the greatest amount of impacts, while Alternative G has the least amount of impacts (399.4 acres).

5.2.50 KSNPC Listed and DBNF Sensitive Species

Fourteen KSNPC listed species were identified during field surveys for this project. Table 5.2.50-1 lists KSNPC listed species identified during field surveys that would be directly impacted by construction of one or more of the proposed alternatives (i.e., the number of times the alternative crosses the area in which the species was located). No KSNPC-derived information regarding the location of any KSNPC or federally listed species appears on any project mapping per contractual agreement with KSNPC.

From Table 5.2.50-1 the southern maidenhair-fern (figure 5.2.50-1), the punctuate coil and the Appalachian cave crayfish would be directly affected by construction of one or more of the proposed alternatives. Direct impacts to the southern maidenhair fern would most likely result in the elimination of the individuals. Impacts to the punctuate coil are difficult to determine since very little information is known about this species. Impacts to the southern cave crayfish are likewise difficult to determine; however, an Interstate crossing over the karst habitat of these species would quite likely exert deleterious effects on them. The karst habitat may be filled in during construction, in which case those crayfish and snail populations would be exterminated. Even if the crayfish habitat is not filled in, the species may still be affected by non-point source pollution. Depending upon the source, amounts and accumulation over time of the pollutants, it could potentially eliminate those populations. See Section 5.2.10-15 and 5.2.19 (Geologic Resources and Geohazards) for further information on karst construction, avoidance, minimization and mitigation.

The southern maidenhair-fern (Adiantum capillus-veneris) population along Buck Creek at Alternative D represents an exemplary population of this species. Occurring at a travertine waterfall in mature woods, and being a large healthy population of the plant give this site a high ecological value.

Figure 5.2.50-1 – Southern Maidenhair-fern Population Along the Alternative D Crossing of Buck Creek

5.2.50-1 Direct Impacts to KSNPC ("State") Listed Species per Alternative

		Pulaski County						Laurel County				
Species	**KSNPC Listing**	**K**	**KY80-Shifted**	**KY80-Modified**	**B**	**D**	**B-D**	**G**	**H**	**I**	**L**	**M**
Flora												
southern maidenhair-fern (*Adiantum capillusveneris*)	Threatened					1						
Punctate coil (*Helicodiscus punctatellus*)	Special Concern	1		1								
Crustaceans												
Appalachian or southern cave crayfish (*Orconectes australis packardi*)	Threatened	1	1	1		1						
Total Impacts per Alignment		2	1	2	0	2	0	0	0	0	0	0

Although this KSNPC listed threatened species is afforded no legal protection, this site presents an excellent opportunity for avoidance and mitigation of an ecologically substantial feature. If Alternative D is selected, avoiding this population would be ecologically prudent and potentially extending the ROW at this location to purchase and preserve the site could help to mitigate the ecological impacts of the project.

For additional information on KSNPC State listed species, including specific species and habitat information, refer to the Terrestrial and Aquatic Baseline Report.

5.2.51 Federally Listed Mussel Species Habitat in the Project Area

Table 5.2.51-1, summarizes impacts to the habitat of most federally and KSNPC listed mussel species, including the federally listed species, Ptychobranchus subtentum (fluted kidneyshell), Epioblasma brevidens (Cumberlandian combshell), Epioblasma capsaeformis (oyster mussel), Pegias fabula (Little-wing pearlymussel), Epioblasma triquetra (snuffbox), Pleurobema oviforme (Tennessee clubshell), and Villosa trabalis (Cumberland bean), and the KSNPC listed species, Alasmidonta marginata (elktoe), Fusconaia subrotunda subrotunda (longsolid), Lampsilis ovata (pocketbook), and Quadrula cylindrica cylindrica (rabbitsfoot). Table 5.2.51-1 does not include substrate habitat preferences for the federally listed Cumberland elktoe (Alasmidonta atropurpurea), Cumberland papershell (Anodontoides denigratus), purple lilliput (Toxolasma lividus), and the KSNPC listed little spectaclecase (Villosa lienosa), which are commonly found in substrates other than those of the majority of freshwater mussels. Each alternative is ranked according to the amount of impacts it has on the resource, with 1 representing the least amount of impact. Mussel habitat determined to be of poor quality was not used to calculate impacts to most federally and KSNPC listed mussel species.

The Pulaski County alternative with the greatest impacts to good quality mussel substrate habitat is Alternative D (0.46 acres), while the alternative with the least amount of impacts to this habitat is Alternative KY80-Shifted (0.05 acres). The Laurel County alternatives with the greatest impacts to good quality mussel substrate habitat are alternatives H and I, each (0.68 acres), while the alternative with the least amount of impacts to this habitat is Alternative L (0.59 acres).

The greatest amount of impacts to marginal quality mussel substrate habitat among the Pulaski County alternatives is Alternative D (0.42 acres), while the least amount of impacts to this habitat occurs from alternatives B and B-D (0.07 acres). Among Laurel County alternatives, Alternative L has the greatest amount of impacts (0.11 acres) to marginal quality substrate habitat, while Alternative I has the least amount of impacts to this habitat (0.01 acres).

Impacts to Villosa lienosa (little spectaclecase), Toxolasma lividus (purple lilliput), Alasmidonta atropurpurea (Cumberland elktoe) and Anodontoides denigratus (Cumberland papershell) habitat are summarized in Table 5.2.51-2. Each alternative is ranked according to the amount of impacts it has on the resource, with 1 representing the least amount of impact.

Not all the federally listed species listed in Table 5.2.51-2 are known from all the streams sampled during the mussel survey. Thus, there are no impacts to A. atropurpurea or A. denigratus habitat (known in the project area only from Sinking Creek in Laurel County) from any of the Pulaski County alternatives. Likewise, because T. lividus is known in the project area only from Buck Creek in Pulaski County, the habitat of this species would not be impacted by any Laurel County alternative. V. lienosa is known from the project area from both Buck Creek and the Rockcastle River; therefore, its habitat would be impacted by all the alternatives.

The Pulaski County alternative with the greatest amount of impacts to V. lienosa habitat is Alternative D (0.55 acres), while the alternative with the least amount of impacts is Alternative KY80-Shifted (0.09 acres). All Laurel County alternatives would impact the habitat of this species equally (0.40 acres, each). T. lividus habitat is impacted the most by Pulaski County Alternative D (0.52 acres), while Alternative KY80-Shifted has the least amount of impacts (0.06 acres) to the habitat of this species. A. atropurpurea and A. denigratus habitat is impacted the most by Laurel County Alternative L (0.23 acres), while alternatives G and M have no impacts to the habitat of these species.

Table 5.2.51-1 Impacts to Habitat1 Most Federally and KSNPC Listed Freshwater Mussel Species per Alternative

Alternative	Impacts to Substrate (in acres)1				
Pulaski County	**Good**	**Marginal**	**Total Good and Marginal Habitat**	**Alternative Ranking**	**Poor**
K	0.10	0.08	0.18	1	0.68
KY80-Shifted	0.05	0.30	0.35	4	0.13
KY80-Modified	0.10	0.08	0.18	1	0.68
B	0.20	0.07	0.27	3	0.07
D	0.46	0.42	0.88	5	0.73
B-D	0.19	0.07	0.26	2	0.07
Laurel County					
G	0.61	0.02	0.63	1	0.13
H	0.68	0.05	0.73	4	0.02
I	0.68	0.01	0.69	2	0.00
L	0.59	0.11	0.70	3	0.09
M	0.61	0.02	0.63	1	0.13

[1] Substrate habitat quality based on a preponderance of freshwater mussel species (73%) found in a sand/gravel/cobble substrate. (Field Measurement)

Table 5.2.51-2 Impacts to Habitat[1]of Selected Federally and KSNPC Listed Freshwater Mussel Species per Alternative

Alternative	Impacts to Substrate (in acres)				
Pulaski County	***Villosa lienosa* (Buck Creek and Rockcastle River)**	***Toxolasma lividus* (Buck Creek)**	***Alasmidonta atropurpurea* & *Anodontoides denigratus* (Sinking Creek)**	**Total Impacts (in acres)**	**Alternative Ranking**
K	0.14	0.11	0.00	0.25	2
KY80-Shifted	0.09	0.06	0.00	0.15	1
KY80-Modified	0.24	0.21	0.00	0.45	4
B	0.20	0.17	0.00	0.37	3
D	0.55	0.52	0.00	1.07	5
B-D	0.20	0.17	0.00	0.37	3
Laurel County					
G	0.40	0.00	0.00	0.40	1
H	0.40	0.00	0.14	0.54	3
I	0.40	0.00	0.04	0.44	2
L	0.40	0.00	0.23	0.63	4
M	0.40	0.00	0.00	0.40	1

[1] Substrate habitat based on information from Cicerello and Schuster 2003.

What is the Endangered Species Act (ESA) and What Species Does it Protect?

The ESA of 1973 states that Federal agencies must ensure that their actions are not likely to jeopardize (reduce the likelihood of survival and recovery) the continued existence of Threatened and Endangered Species or destroy or adversely modify Critical Habitat.

What About Species not Covered Under the ESA?

The mitigation efforts outlined in this document for the species listed as Federally Threatened or Endangered is required by the ESA. Additional mitigation efforts for certain Species of Concern, as well as State Listed species will be considered by the FHWA and KYTC in the spirit of environmental stewardship in the implementation phase of the proposed project.

Faunal (Wildlife) Mitigation

5.2.52 Avoidance, Minimization and Mitigation of Impacts to Project Area Fauna

Project Area Bat Species

Mitigative measures will be necessary to avoid, minimize and mitigate impacts to any Indiana and gray bats within the project area. Areas of habitat conducive to bat foraging and maternity habitat (for Indiana bat) can be found within and near the project impact area. Additional measures could be implemented to mitigate for KSNPC Rafinesque's and eastern small-footed bats.

Indiana Bat

Indiana bat females typically form maternity colonies in summer under exfoliating tree bark to raise their young. Indiana bat maternity colonies may include as many as 400+ mothers and young. Roost trees are typically > 9 inches in diameter at breast height (dbh) and a colony may occupy multiple trees with one or more primary tree(s). Indiana bat maternity colonies have been reported to practice site fidelity from year to year, making fragmentation of forested areas especially troublesome. Both male and non-reproductive female Indiana bats utilize dead and dying trees > 5 inches dbh for non-maternity roosting habitat. The bats will utilize snags, hollow trees, split-trunk trees and live trees with loose bark.

Further coordination with USFWS will be conducted as a part of the Biological Assessment. If necessary, the appropriate mitigation measures, for the Indiana bat habitat described above, will be taken.

Indiana bats were not captured during an endangered bat survey during field surveys conducted for this project; however, an Indiana bat was identified from Blowing Cave in Pulaski County in November, 1991 (Personal communication with Traci Wethington November 2004), and correspondence with KSNPC (2004) indicated that they have been identified from nearby areas (1989 – several miles South West of the beginning of the project).

Gray Bat

Gray bats were identified from several streams within the project area during endangered bat surveys for this project. Because gray bats typically forage over streams and other water bodies, water quality is of utmost importance. Pollution, siltation, dam-influenced flooding of cave roosts, pesticides, deforestation and other factors which negatively impact aquatic insect habitat have an adverse effect on gray bat populations (Bat Conservation International, Inc. 2001). Deforestation is one of the most detrimental factors influencing gray bat populations, especially when it occurs around bat watercourse foraging corridors and reservoirs (Mitchell and Martin 2002). It is recommended that aquatic ecosystems where gray bats have been identified will be preserved or revegetated with native, regionally common hardwood trees to control soil erosion and turbidity and preserve bat foraging habitat.

Gray bats are totally reliant on a few caves year-round for their survival. Caves within the proposed project area known be used by the gray bat, and KSNPC listed Rafinesque's big-eared should be avoided. These caves may also be used by more common bat species such as northern, big brown, little brown, and eastern pipistrelle bats. A wooded buffer of at least 300 feet around cave entrances and any riparian corridors within the foraging range of these caves should be maintained to protect cave-dependent bat species. Gray bats were identified from several caves within the project area, including a male juvenile during the summer of 2004. This cave may serve as a maternity site for gray bats, but because only one juvenile gray bat was identified from it, further study is recommended to determine its status as a maternity site. A possible mitigation for gray bats is the purchase of known area gray bat caves by the KYTC. These caves could be held in perpetuity, gated and kept locked to discourage vandalism. Appropriate mitigation measures for the gray bat will be followed in accordance with USFWS guidance and consultation.

Additional Measures Possible for KSNPC Listed Bat Species

Several KSNPC listed bats were identified from under bridges within the project area. The following is suggested mitigation for bridge construction at locations where KSNPC listed species were identified:

- Erosion and siltation controls will include, but not necessarily be limited to: silt fences, brush barriers, sediment basins, diversion ditches, and rock check dams. These measures will be used singly or in combination, as needed, to provide the maximum level of erosion control. They will be installed prior to construction and will be inspected and repaired regularly as needed.
- There will be no alteration or realignment of the stream channel.
- No equipment will be operated in the stream channel.
- No excavation of the stream channel will occur to obtain construction materials.
- If temporary stream crossings are needed, they will be perpendicular to the stream channel and will span the stream if possible. If spanning is not possible, provisions will be made to allow for normal, high, and low flows to continue without obstruction in the natural stream channel.
- Equipment cleaning/staging areas will be located such that runoff from those areas will not enter the stream.
- If storage of fill material is necessary, it will be stored such that runoff from the storage areas does not enter the stream.
- The permanent bridge will span the stream if possible. If instream piers are needed, they will be designed and oriented in the channel such that blockage of flow does not occur.
- Piers and abutments will be poured off site and hauled to the site for installation. If this is not possible, pouring of concrete will be done such that spills into the stream do not occur.
- An inspector with the authority to halt construction will be onsite during pouring of concrete.
- All disturbed areas will be seeded or stabilized with straw mulch in accordance with standard specifications. Areas impacted by construction activities at the stream will be planted on a six foot by six foot spacing with equal number of the following tree seedlings: 1) green ash (*Fraxinuis pennsylvanica*), 2) American sycamore (*Platanus occidentalis*), and 3) northern red oak (*Quercus rubra*).
- Stay in place forms (metal decking) will not be used from the beginning of the bridge at each side to a distance of 50 feet and the concrete deck will be roughened by the use of textured removable forms or other appropriate measures to be friendlier to roosting bats.
- The placement of plywood baffles and roughening of the deck with spraycrete under the existing KY80 bridges over the Rockcastle River and Buck Creek should be considered and coordinated with KDFWR and USFWS.
- If Alternative I is not selected, the potential gating of the Rafinesque's bat cave should be closely coordinated with USFS as this cave occurs on Forest Service property. If Alternative I is selected, Rafinesque's big-eared bats would likely abandon the site, and gating of this Significant Bat Cave would not be necessary.

For additional information on KSNPC listed species and habitat information, refer to the Terrestrial and Aquatic Baseline Report.

Freshwater Mussels

Any crossings over the Rockcastle River, Buck and Sinking creeks will be completely spanned from floodplain to floodplain, and bridges will be designed with a closed deck drainage system, such that water draining the deck does not directly enter the stream. Best Management Practices to prevent soil erosion and sedimentation to streams will be used at all times during construction. Riparian ecosystems will be preserved, or revegetated with native, regionally common hardwood trees to control soil erosion and turbidity to preserve freshwater mussel habitat. As certain bridge designs can facilitate siltation as bridge drainage systems degrade, bridge inspection and quick correction of problems over the Rockcastle River, Buck Creek and Sinking Creek could help to prevent degradation of mussel populations in these streams. A possible mitigation to freshwater mussels is the investigation of the purchase by the KYTC of the section of Sinking Creek and about 60 feet (about 18 meters) of riparian zone on either side of its banks upstream from the Proposed Designated Critical Habitat for restoration purposes. Restoration of this section of the stream would have a beneficial affect on all freshwater mussel species downstream within the Proposed Designated Critical Habitat, including KSNPC and federal listed species. See, also, 5.2.31 (Waterways and Riparian Vegetation).

Bald Eagle

The bald eagle is known to nest at Laurel River Lake in Laurel County, and to forage along the Cumberland River as far as Lake Cumberland (Personal communication with John Omer, USDAFS biologist, London District, Spring 2004). The closest proposed alternative (Alternative I) to this area is approximately three to five miles from Laurel River Lake. Bald eagles are known to be disturbed by human activity such as land development; however, Alternative I is located beyond even the secondary zone of known bald eagle nesting habitat in Laurel River Lake, and so is unlikely to be adversely affected by project construction. The secondary zone is an area radiating a distance of 750 feet to 1 mile from the nest tree (USDAFS April 1989).

5.2.53 Additional Species Listings by USFWS in Project Area

While field surveys were conducted on all species listed for the project area the USFWS released new county lists issued by USFWS on June 1st, 2005 identified the potential presence of five additional species in Pulaski and Laurel Counties, KY. The additional species are:

- Eggert's sunflower (Helianthus eggertii)
- Fanshell (Cyprogenia stegaria)
- Purple catspaw pearlymussel (Epioblasma o. obliquata)
- Ring pink (Obovaria retusa)
- Rough pigtoe (Pleurobema plenum)

Of these five species, four are freshwater mussels. Surveys for mussel species conducted were not species specific. All mussel species were identified during surveys and all general mussel habitats in major streams within the project area were surveyed. Mussel surveys conducted sufficiently address potential impacts these species as well as those listed during earlier coordination activities.

No specific surveys were conducted for Eggert's sunflower. As Pulaski and Laurel Counties, KY are now considered to be potential habitat for this species, surveys should be conducted for Eggert's sunflower prior to any construction/clearing activities associated with the I-66 project should the species remain on the Federal Threatened and Endangered Species List (proposed for de-listing, Federal Register, Vol. 65 No. 65, April 5, 2005, 50 CFR Part 17).

5.2.54 Control of Invasive Species

Executive order 13112, signed by then President Clinton on Feb 3, 1999, directs federal agencies to attempt to control the introduction and spread of invasive species that may harm the environment, human health or the economy. This order builds on NEPA (1969), the Federal Noxious Weed Act (1974), and the ESA (1973). Under Executive Order 13112, federal funds cannot be used for projects that "are likely to cause or promote the introduction or spread of invasive species...unless all reasonable measures to minimize risk of harm have been analyzed and considered" (U.S. Department of Transportation 2000).

Attention will be given to minimizing soil disturbance during vegetation management activities. Wherever practicable (i.e., floral species that are not cost-prohibitive, and are readily available), revegetating with native, regionally- and site-appropriate herbaceous and woody vegetation will be included. The FHWA promotes the use of native plants for erosion control, landscaping and maintenance of highway ROW due to their hardiness in their native habitats and to help preserve out natural heritage (U.S. Department of Transportation 2000). The use of native plants in revegetating along highway ROW results in a myriad of benefits, including:

- Erosion control - Because many of the grasses and forbs have deep and/or fibrous root systems, they add to the strength of the slope and prevent unwanted erosion. The associated problem with their use for erosion control has been their long establishment time because many species are perennial. However, some cool season, quick- to- establish native grasses do exist and act much like the annual ryes used previously.

- Vegetation management - A reduction in mowing and spraying is often possible when using existing native plants. The Texas Department of Transportation and many others save millions of dollars annually in reduced maintenance.

- Biodiversity - A diversity of grasses, forbs, shrubs and vines can be maintained in contrast to the conventional mowed grass monocultures.

- Wildlife habitat - A biodiversity of native vegetation provides food and shelter for wildlife whose habitat is rapidly diminishing.

- Wetland mitigation - Using native plants in wetland creation or restoration is more likely to be successful in producing functioning, diverse wetland habitats.

- Endangered species - Exotic invasive species often displace native species. By protecting native plant remnants, undiscovered endangered species may also be protected, as well as protecting existing endangered species from displacement by exotic invasive plants.

- Water quality - The runoff from sod or common turfs is far greater than from deep rooted native grasses. Native grasses capture much of precipitation before it hits the ground, and their deep roots absorb the run off better. Therefore, normal rainfall has less opportunity to pick up fertilizers, agricultural runoff, and other sources of nonpoint source pollution, which may foul area streams.

- Hardy vegetation - Regional native vegetation is adapted to the area's climate, soils, etc. When plants are matched carefully, survival should be assured, thereby eliminating future costs.[10]

The Terrestrial and Aquatic Baseline Report (February 2005) contains a list of suggested species for revegetating riparian and channel areas. This list includes seeds of some nonnative grass species due to ease and likelihood of becoming established quickly. Quick establishment of vegetative cover protects the banks from erosion and reduces the likelihood and severity of soil eroding into the streams. Whenever planting must be delayed, temporary erosion protection with weed-free mulches, biodegradable fiber mats, and non-petroleum dust palliatives will be provided where instructed by the project engineer. Guidance on the use of roadside native plants along highway ROW can be found in the FHWA handbook, "Roadside Use of Native Plants" (U.S. Department of Transportation 2000), and the Executive Memorandum on Environmentally Beneficial Landscaping.[11]

[10]http://www.fhwa.dot.gov/environment/rdsduse/rd_use21.htm
[11]http://www.afcee.brooks.af.mil/dc/dcd/land/ldg/execmemo.doc

5.2.55 Migratory Bird Treaty Act Compensation

Project biologists were advised by the USFS to include agency coordination for the Migratory Bird Treaty Act (MBTA), particularly as it pertains to the DBNF Land Use Management Plan (USDAFS 2004). The Migratory Bird Permit Memorandum on Nest Destruction, April 15, 2003 clarifies the application of the MBTA to migratory bird nests. This memorandum states that the destruction of unoccupied nests is not prohibited under the MBTA, unless possession occurs; however, it makes clear that nest destruction as "unpermitted take of migratory birds or their eggs, is illegal and fully prosecutable under the MBTA" (Migratory Bird Permit Memorandum April 15, 2003). Consultation with USFS regarding the MBTA will be conducted prior to the letting of this project.

Because the DBNF has a management plan that relies upon bird monitoring data to track the progress of its goals, the following measures will be considered, where practicable, during the construction phase of the project:

- Avoidance of riparian corridor forest, 80 years old or older – benefit to the Acadian flycatcher.
- Avoidance of dense cove forests, 80 years old or older – benefit to the black-throated green warbler.
- Avoidance of upland hardwood or mixed hardwood/yellow pine forests between 60 to 80 basal area (BA), and greater than 41 years old.
- Avoidance of upland hardwood or mixed hardwood/yellow pine forests between 30 to 60 BA, and greater than 50 years old – benefit to the summer tanager.
- Avoidance of upland hardwood or mixed hardwood/yellow pine forests, less than 30 BA with grassy layer, and greater than 50 years old – benefit to the chipping sparrow.
- Avoidance of upland hardwood or mixed hardwood/yellow pine forests, less than 30 BA with shrub layer, and greater than 50 years old – benefit to the northern cardinal.
- Avoidance to grasslands, including old fields, prairie remnants and wooded grasslands – benefit to the field sparrow.
- Avoidance of any wooded type, recently cut-over, and 10 years or less in age – benefit to the eastern towhee and the yellow-breasted chat.

- Avoidance of older forest, between 70 to 90 BA for southern pine-oak communities, and up to 130 BA for mesic communities – benefit to the ovenbird.
- Avoidance of yellow pine communities, between 70 to 90 BA and 41 years old or more – benefit to the pine warbler.
- Avoidance of yellow pine communities, up to 10 years old, such as those recovering from southern pine beetle infestations – benefit to the prairie warbler.
- Avoidance of woodlands and wooded grasslands with predominately mature yellow pine or mixed yellow pine-hardwood, between 20 to 30 BA, with a predominately warm-season grasses and forbs herbaceous layer with scattered patches of brush – benefit to the northern bobwhite quail.

KSNPC Listed Bird Species:

It is possible and even probable that any of the federally or KSNPC listed species known from the project area could occur on the DBNF. Possible measures to avoid impacts to federally or KSNPC listed species within the project area include, but are not limited to, the following:

- Avoidance of thick coniferous, deciduous or mixed forests – benefit to sharp-shinned hawk.
- Avoidance of hayfields and weedy fields, especially those that are left undisturbed until after they've attained maturity – benefit to Henslow's sparrow and sedge wren.
- Avoidance of aquatic habitats, such as ponds, rivers, and lakes, and their riparian zones – benefit to great blue heron.
- Avoidance of thick brushy areas and thickets, especially those devoid of or limited in exotic invasive plant species, and those that contain small cavity trees – benefit to Bewick's wren.

The above measures do not include the bald eagle and the red-cockaded woodpecker, as it unlikely that these species would be directly affected by the construction of the proposed project.

Because the habitats to avoid are prevalent within the project area on the DBNF, it is unrealistic that all of them can be effectively avoided during the construction phase of this project; therefore, further coordination with the DBNF and USFWS will take place in order to discuss appropriate protection and avoidance measures that may be practicable for the construction phase of the project.

5.2.56 Permits that May be Necessary for Terrestrial and Aquatic Resources

The following Federal permits relating to terrestrial and aquatic resources may be required for the proposed project:

USACOE	Section 404 Permit for Discharge of Dredged or Fill Material

The following Kentucky State permits relating to terrestrial and aquatic resources may be required for the proposed project:

KNREPC-DOW	Section 401 Water Quality Certification

These permits will be obtained at the appropriate phase of final design should a build alternative be selected.

5.2.57 Alternative Analysis and Recommendations based on Terrestrial and Aquatic Studies in the Project Area

In order to provide a ranking of the build alternatives, alternative impacts to major ecological resources were compared. In the event that two or more alternatives had impacts that were equal or nearly equal, a tie was assessed for the impact ranking to that resource. As the project occurs in Pulaski and Laurel Counties with all build alternatives joining at the county line, Pulaski County alternatives are compared only with other Pulaski County alternatives and Laurel County alternatives are compared only with other Laurel County alternatives.

<u>No Build Alternative</u>

The No Build Alternative will have none of the substantial adverse impacts to the ecology of the area associated with all the build alternatives.

<u>Pulaski County Alternatives</u>

Much of the project corridor generally follows the existing KY80 on the Pulaski County side of the project; therefore, a number of impacts occur within the existing disturbance around KY80, particularly with alternatives K, KY80-Shifted, and KY80-Modified. Most notable among these impacts are impacts to karst features, streams and wetlands. Although many of these features still maintain a relatively high ecological value, it is important to note in the comparison of build alternatives that the quality of these features has already been compromised in varying extents from the impacts of the existing roadway and associated development.

<u>Alternative K</u>

Alternative K follows a similar alignment (along existing KY80) to alternatives KY80- Shifted and KY80-Modified, except near the beginning of the project where it dips further to the south avoiding some of the extensive impacts to Flat Lick Creek. In following close to the band of disturbance along KY80, this alternative avoids some of the habitat fragmentation impacts associated with Alternative D, which cuts cross country for much of its length. Alternative K's Buck Creek crossing at the existing KY80 bridge location, where riparian vegetation has already been disturbed, is preferable to the more pristine downstream crossing utilized by Alternative D. Although Alternative K would cross Buck Creek at the location of the existing KY80 Bridge, it would require an additional bridge crossing for an access road adjacent to and upstream of the KY80 Bridge. The additional bridge makes Alternative K's crossing less desirable than the single bridge Buck Creek crossings of alternatives KY80-Shifted, B and B-D.

The ROW for Alternative K has a total impact area of 1,036 acres. Alternative K has the second greatest impacts to karst features and the greatest impact to rare karst fauna. This alternative ties with KY80-Modified for the second greatest impact to intermittent and ephemeral streams. Alternative K ties with Alternative B for the greatest impacts to the DBNF, although all Pulaski County alternatives have similar impacts to the DBNF. Alternative K has the least impact to forested habitat, and ties for the second least impact to high quality mussel substrates.

<u>KY80-Shifted</u>

KY80-Shifted follows along existing KY80 for the majority of its length with a similar alignment to KY80-Modified. In following close to the band of disturbance along KY80, this alternative avoids most of the habitat fragmentation impacts associated with Alternative D which cuts cross country for much of its length. KY80-Shifted crosses Buck Creek at Stab just south of the existing KY80 crossing. As riparian vegetation and streambanks are already disturbed here from KY80 and County Road 1675, this crossing is preferable to the more pristine downstream crossing utilized by Alternative D. KY80-Shifted would not require the additional bridge crossing of Buck Creek that is proposed for alternatives KY80-Modified and Alternative K.

The ROW for KY80-Shifted has a total impact area of 1,081 acres. KY80-Shifted would have second greatest impact to perennial streams and ties for the greatest impact to wetlands. KY80-Shifted has the second least amount of impacts to the DBNF and ties with Alternative K for the second least impacts to federally listed Endangered, Threatened and Candidate species. KY80-Shifted, Alternative B and Alternative B-D tie for the least impact to KSNPC listed species and federal Species of Management Concern. Alternative KY80-Shifted has the least impact to high quality mussel habitat and ties with KY80-Modified for the least forest fragmentation impact.

<u>KY80-Modified</u>

KY80-Modified follows along existing KY80 for the majority of its length with a similar alignment to KY80-Shifted. In following close to the band of disturbance along KY80, this alternative avoids most of the habitat fragmentation impacts associated with Alternative D, which cuts cross country for much of its length. KY80-Modified crosses Buck Creek at the location of the existing KY80 crossing. As riparian vegetation and streambanks are already disturbed here from KY80, this crossing is preferable to the more pristine downstream crossing utilized by Alternative D; however, KY80-Modified, like Alternative K, would require an additional bridge crossing of Buck Creek for a proposed access road.

The ROW for KY80-Modified has a total impact area of 1,320 acres, the greatest of any build alternative. The impacts to forested habitats from KY80-Modified are greater than any other alternative, except for Alternative D. This alternative has the greatest impacts to karst features and the second greatest impacts to rare karst fauna. It has the greatest impact to federally

listed Threatened, Endangered and Candidate species, KSNPC listed species and federal Species of Management Concern. KY80-Modified would have the greatest impacts to perennial streams and the second greatest impact to ephemeral and intermittent streams. KY80-Modified and KY80-Shifted tie for the greatest impacts to wetlands. Impacts to the DBNF would be less from KY80-Modified than from any other build alternative.

Alternative B

For the majority of the project, Alternative B travels parallel to existing KY80, but just outside the existing ROW. At the start of the project, Alternative B follows a similar alignment to Alternative K, dipping further to the south and avoiding some of the extensive impacts to Flat Lick Creek. Alternative B crosses over existing KY80 and crosses Buck Creek north of KY80 and all the other build alternatives. The Alternative B crossing here does not require an additional bridge for an access road, which is preferable to the crossings of KY80-Modified and Alternative K. Alternative B's crossing of the eastern bank of Buck Creek would impact cliffline habitat and a population of the federal SOMC and KSNPC Threatened northern white cedar. From this point, Alternative B continues on parallel to existing KY80, but north of the existing ROW until it joins back in with KY80 just east of Lacy Fork prior to the Rockcastle River crossing.

The ROW for Alternative B has a total impact area of 871 acres, which is the second lowest of all the build alternatives. Alternative B ties with Alternative K for the greatest impacts to the DBNF, although all Pulaski County alternatives have similar impacts to the DBNF. Impacts to high quality mussel habitat from Alternative B are the second greatest of the build alternatives. Alternative B ties with Alternative B-D for the least impacts to federally listed Threatened, Endangered and Candidate species, KSNPC listed species, federal Species of Management Concern, karst features and rare karst fauna. Alternative B has the second least impact to intermittent and ephemeral streams and ties with alternative D for the second least impacts to wetlands.

Alternative D

At the start of the project, Alternative D follows the same alignment as alternatives K, B, and B-D; however, rather than turning north to meet existing KY80, Alternative D stays south of the KY80 and the other alternatives cutting cross country over a new alignment until it joins the other alternatives east of Line Fork. In following this southerly alignment, Alternative D avoids many of the karst impacts, including impacts to the main trunk of the Sinking Valley, which all other alternatives cross; however, in cutting cross country, Alternative D impacts a variety of habitats that retain a more natural character than those which more closely follow existing KY80. The Buck Creek Crossing for this alternative would occur in an area where the riparian vegetative communities and physical stream characteristics are healthier and more intact than those of the other alternatives.

The ROW for Alternative D has a total impact area of 915 acres. It ties with Alternative B-D for the second greatest impacts to the DBNF (with all Pulaski County alternatives having similar impacts to the DBNF). Alternative D has the greatest impacts to forested habitats, intermittent and ephemeral streams, high quality mussel habitat, and fragmentation of all the build alternatives. Alternative D ties with Alternative K for the second greatest impacts to KSNPC listed species and federal SOMC.

Although Alternative D ties with KY80-Modified for the greatest number of impacts to federally Threatened, Endangered and Candidate species, when considered qualitatively, the impacts to these federally protected species is higher from Alternative D than from other alternatives. Alternative D impacts higher quality mussel habitat at the only site on the project were the Cumberlandian combshell was identified and has similar impacts to gray bat sites as Alternative KY80-Modified. While Alternative D has a smaller number of impacts to KSNPC listed species and federal Species of Management Concern than KY80-Modified and the same number of impacts as Alternative K, it impacts a very substantial population of KSNPC Threatened southern maiden-hair fern along a travertine waterfall, and a population of the KSNPC Threatened northern white cedar that no other alternative would affect.

Alternative B-D

The ROW for Alternative D has a total impact area of 831 acres, the least of any build alternative. Alternative B-D shares the alignment of Alternative B at the beginning of the project and crosses over to follow Alternative D approximately one mile east of the KY80 crossing of Bolger Hollow. This alternative utilizes the same crossing of Buck Creek north of KY80 as Alternative B. No additional access road bridge over Buck Creek is required for this alternative.

Alternatives B-D and B have the least impact to federally listed Threatened, Endangered and Candidate species. Alternative B-D ties with alternatives B and KY80-Shifted for the least impacts to KSNPC and federally Species of Management Concern. It ties with Alternative B for the least direct impact to karst features and rare karst fauna. While Alternative B-D would not require extensive new fragmentation as does Alternative D, it increases the fragmentation along existing KY 80 by running parallel to KY80, but largely outside the existing managed ROW. This creates a larger barrier to wildlife species that require wooded habitat and opens up a greater area for invasive species to become established.

Laurel County Alternatives

Alternative G

Alternative G follows KY80, staying largely along the existing ROW, thereby avoiding some of the fragmentation impacts associated with Alternative I and to a lesser extent Alternative H, past the headwaters of Poison Honey Fork. From there, it veers southeast toward its intersection with I-75. Alternative G leaves the DBNF at KY 192, after which point rural development occurs more frequently within the landscape. Alternative G crosses Sinking Creek upstream of all other alternatives except Alternative M, which utilizes the same crossing. Through this stretch of Sinking Creek, the physical characteristics of the stream and riparian vegetation are in largely undisturbed as steep topography hasn't allowed the intrusion of man. Past Sinking Creek, Alternative G traverses areas dominated by farms where most upland areas are subject to rural development and forested areas are restricted to within steep valleys. This condition continues though Alternative G's intersection with I-75.

The ROW for Alternative G has a total impact area of 1,137 acres, the greatest of any Laurel County alternative. Alternative G ties with Alternative M for the greatest impacts to KSNPC listed species and federal SOMC. Alternative G has the greatest impacts to perennial streams and ties with Alternative I for the second greatest impacts to intermittent and ephemeral streams.

Alternatives G and M have the second least impact to the DBNF and G and L have the second least impact to area wetlands (by assigned value score). Alternative G has the least impact to forested habitat and high quality mussel habitat. Fragmentation impacts from Alternative G are less severe than from any other Laurel County build alternative.

Alternative H

Alternative H follows existing KY80 (and alternatives G, L, and M) past Pine Creek Gorge and then begins to veer south. Like Alternative G, it leaves the DBNF at KY 192, although slightly further south. At this point rural development occurs more frequently within the landscape. It crosses Sinking Creek approximately ½ mile upstream from the Willy Green Road crossing in a disturbed area that demonstrates streambank instability. After Sinking Creek, Alternative H moves increasingly into a farm setting where most upland areas are subject to rural development and forested areas are restricted to within steep valleys. This landscape condition continues though Alternative H's intersection with I-75.

The ROW for Alterative H has a total impact area of 1,068 acres. Alternative H has the second greatest impacts to the DBNF, total forested habitat, and high quality mussel habitat. This alternative would have the greatest impact to intermittent and ephemeral streams and ties with Alternative M for the greatest impact to wetlands (by assigned value score). Fragmentation impacts from Alternative H are the second greatest of any Laurel County build alternative. Alternative H ties with Alternative I and L for the least number of impacts to perennial streams, and KSNPC listed species and federal SOMC.

Alternative I

Alternative I follows existing KY80 for approximately ¾ mile east of the Rockcastle River and then continues due east while the other alternatives follow KY80 to the northeast. Alternative I passes on a sideslope and ridge of a 1st order perennial tributary of Pine Creek. The sideslope has abundant clifflines, including a cave-like rockshelter, which houses a large maternity colony of the KSNPC Sensitive, federal Species of Management

Concern Rafinesque's big-eared bats. This site is considered a Significant Bat Cave by the DBNF. [See Significant Bat Caves in Section 4.5.1 (Daniel Boone National Forest)]. Pine Creek Gorge is crossed by Alternative I 2,000 feet south of KY 80, where this new alignment, as designed, would require placing fill material with a footprint of approximately 14.77 acres into pristine hemlock forest. From Pine Creek Gorge, Alternative I continues east to a designed interchange with KY80 that extends from Alternative I 4,400 feet north to KY80. The access road for the interchange here would require an additional impact to Poison Honey Fork. Alternative I continues east until it meets Alternative H south of Bernstadt. From there, Alternative I turns southeast following a similar alignment to Alternative H. Alternative I crosses Sinking Creek at the existing crossing of Willie Green Road where the stream is already highly disturbed. This stretch of Sinking Creek is the most degraded area within the entire length of the stream. After Sinking Creek, Alternative I traverses farmlands more frequently, where most upland areas are subject to rural development and forested areas are restricted to within steep valleys. This landscape condition continues though Alternative I's intersection with I-75.

The ROW for Alterative I has a total impact area of 1,002 acres, the least of any build alternative. Alternative I would have the greatest impacts to the DBNF and the greatest impacts to forested habitats. This alternative ties with Alternative G for the second greatest impacts to intermittent and ephemeral streams. The fragmentation impact from Alternative I would be greater than from any other alternative. Alternative I would have the least impact to perennial streams and wetlands (by assigned value score).

Alternative L

Alternative L follows along the same alignment as Alternative G from the Rockcastle River to KY 1535, where it veers further to the south crossing Sinking Creek immediately downstream of its confluence with Powder Mill Creek. In this reach, Sinking Creek is disturbed and demonstrates bank instability. From this point, Alternative L continues southeast to join Alternative H. Alternative L shares common ROW with Alternative H until Maple Grove Road where it again breaks further south to join Alternative I. Alternative H utilizes the same I-75 interchange as Alternative I.

The ROW for Alterative L has a total impact area of 1,066 acres. Alternative L ties with Alternative H for the greatest impact to high quality mussel habitat. Alternative L has the least impact to the DBNF. Alternatives L, I and H tie for the least impact to KSNPC listed species and federal SOMC and has the least impact to perennial streams. It has the second least impact forested habitat and intermittent and ephemeral streams. Fragmentation impacts from this alternative are the second least of all build alternatives.

Alternative M

Alternative M follows along the same alignment as Alternative G from the Rockcastle River across Sinking Creek to KY 192 where it veers south to meet Alternative I. It joins I just west of KY 363 and has identical ROW to Alternative I through the end of the project. The impacts from this alternative are very similar to those of Alternative G.

The ROW for Alterative M has a total impact area of 1,019 acres. It ties alternative G for the greatest number of impacts to KSNPC listed species and federal SOMC. Alternative M ties Alternative H for the greatest impacts to wetlands (by assigned value score). Alternative M has the least impacts to intermittent and ephemeral streams and ties with Alternative G for the least impacts to high quality mussel habitat. This alternative ties with Alternative G for the second least impacts to the DBNF and ties with Alternative L for the second least impacts to forested habitats.

Recommendations Based on Ecological Studies

The build alternatives were compared based in large part on their impacts to the following resources: forested habitat, federally listed Threatened, Endangered, and Candidate species, KSNPC listed species and communities, perennial streams, intermittent and ephemeral streams, wetlands, karst features, rare karst fauna, freshwater mussel habitat, the DBNF, and contiguous forested areas (fragmentation impacts). After quantitative comparison of the alternatives, additional consideration and weighting was applied based on factors that could not be considered quantitatively. For example, where one listed bat species was identified from a site located along an alternative versus an entire maternity colony of listed bats identified along another, the impacts from the alternative where the maternity colony was identified were weighted more heavily. Once the comparisons were made, the alternatives were assigned values of: No Impact (No Build), Least Impact, Medium Impact, and Greatest Impact.

Pulaski County Alternatives:

No Build:	No Impact
Alternative K:	Medium Impact
KY80-Shifted:	Least Impact
KY80-Modified:	Greatest Impact
Alternative B:	Medium Impact
Alternative D:	Greatest Impact
Alternative B-D:	Least Impact

Laurel County Alternatives:

No Build:	No Impact
Alternative G:	Least Impact
Alternative H:	Greatest Impact
Alternative I:	Greatest Impact
Alternative L:	Least Impact
Alternative M:	Medium Impact

The project area runs through an ecologically diverse and sensitive area in Kentucky and any build alternative selected will have adverse impacts to the ecology of the area. If a build alternative is to be selected, the alternative recommended when considering impacts to area ecology is the combination *KY80-Shifted – L.*

5.2.58 Farmland Impacts and Necessary Mitigation

The Farmland Protection Policy Act requires identification of proposed actions that would affect land classified as prime and unique farmland. The U.S. Natural Resources Conservation Service (NRCS) administers this act to preserve farmland.

In accordance with 7CFR, Part 658 of the National Farmland Protection Policy Act, Land Evaluation criteria and Site Assessment criteria (LESA) were applied to determine effects to farmland within the project area. The land evaluation criterion is a relative value (from 0 to 100) for agriculture production of the farmland to be converted based on information within the local government's jurisdiction. The site assessment criteria are designed to assess important factors other than the agricultural value of the land and consider not only the land currently being farmed, but also the land use around the project area and whether or not that land use is urban, non-urban, or in transition. Each factor within the site assessment criteria is assigned a score relative to its importance. Sites that receive a total site assessment score of 160 points or less are given a minimal level of consideration for protection. The Farmland Protection Act recommends higher protection for alternatives with scores of 160 or higher, and requires agencies to consider uses of land that is not farmland (e.g., residential or industrial areas), which would have lower LESA scores unless there are other overriding considerations.

On June 30, 2004 Form AD-1006 Farmland Conversion Impact Rating was mailed to representatives of the Natural Resources Conservation Service (NRCS) for the two project area counties; Mr. Thomas Jones, District Conservationist for Pulaski County, and Mr. Jeff Moore, District Conservationist for Laurel County. Please refer to Appendix B for copies of these letters, as well as the completed AD-1006 Form.

Pulaski County Farmland Impacts

In Pulaski County, impacts to area farmlands were assessed for the following Build Alternatives; Alternative B, Alternative K, Alternative D and the common alignment of Alternative B-D. None of these proposed alignments scored above the 160-point threshold requiring mitigation for Farmland Impacts. Impacts to area farmlands were not assessed for Alternatives KY 80 Modified and KY 80 Shifted. These Alternatives are similar to Alternative K in respect to their proposed alignment, and therefore would be similar in the effects to project area farmlands. However, re-coordination with the Pulaski County NRCS office is in progress, the results of which will be appended to the Socioeconomic Baseline Report.

Alternative B

For Part IV of Form AD-1006, Land Evaluation Information, Alternative B contained 54.0 acres Total of Prime and Unique Farmlands. Total Acreage of Statewide and Local Important Farmlands impacted by Alternative B is 168.0. Alternative B would convert 0.005% of Pulaski County farmland to non-agricultural use. Finally, there was 52.9% of Farmland in the local

government jurisdiction with the same, or higher, relative Value. In Part V of AD-1006, Alternative B scored 50.2 on a scale 0-100. In Part VI of Form AD-1006, Alternative B scored 71, of a possible high of 160. The scores of Part V and Part VI were combined for a Total of 121.2 points. Therefore, mitigation for impacts to area farmlands associated with Alternative B would not be required.

Alternative K

For Part IV of Form AD-1006, Land Evaluation Information, Alternative K contained 163.3 acres Total of Prime and Unique Farmlands. Total Acreage of Statewide and Local Important Farmlands impacted by Alternative K is 85.1. Alternative K would convert 0.006% of Pulaski County farmland to non-agricultural use. Finally, there was 70.2% of Farmland in the local government jurisdiction with the same, or higher, relative Value. In Part V of AD-1006, Alternative K scored 36.6 on a scale 0-100. In Part VI of Form AD-1006, Alternative K scored 69, of a possible high of 160. The scores of Part V and Part VI were combined for a Total of 105.6 points. Therefore, mitigation for impacts to area farmlands associated with Alternative K would not be required.

Alternative D

For Part IV of Form AD-1006, Land Evaluation Information, Alternative D contained 58.5 acres Total of Prime and Unique Farmlands. Total Acreage of Statewide and Local Important Farmlands impacted by Alternative D is 138.3. Alternative D would convert 0.005% of Pulaski County farmland to non-agricultural use. Finally, there was 52.9% of Farmland in the local government jurisdiction with the same, or higher, relative Value. In Part V of AD-1006, Alternative D scored 42.7 on a scale 0-100. In Part VI of Form AD-1006, Alternative D scored 70 of a possible high of 160. The scores of Part V and Part VI were combined for a Total of 112.7 points. Therefore, mitigation for impacts to area farmlands associated with Alternative D would not be required.

Alternative B-D

For Part IV of Form AD-1006, Land Evaluation Information, Alternative B-D contained 71.8 acres Total of Prime and Unique Farmlands. Total Acreage of Statewide and Local Important Farmlands impacted by Alternative B-D is 105.9. Alternative B-D would convert 0.005% of Pulaski County farmland to non-agricultural use. Finally, there was 70.2% of Farmland in the local government jurisdiction with the same, or higher, relative Value. In Part V of AD-1006, Alternative B-D scored 37.4 on a scale 0-100. In Part VI of Form AD-1006, Alternative B-D scored 70 of a possible high of 160. The scores of Part V and Part VI were combined for a Total of 107.4 points. Therefore, mitigation for impacts to area farmlands associated with Alternative B-D would not be required.

Laurel County Farmland Impacts

In Laurel County, impacts to area farmlands were determined for the following Build Alternatives; Alternative G, Alternative H, Alternative I, Alternative L and Alternative M. The Farmland Protection Act recommends higher protection for alternatives with scores of 160 or higher, and requires agencies to consider uses of land that is not farmland (e.g., residential or industrial areas), which would have lower LESA scores unless there are other overriding considerations. All alternatives were found to have scores lower than 160. Following is a synopsis of the LESA results in Laurel County:

Alternative G

For Part IV of Form AD-1006, Land Evaluation Information, Alternative G contained 87.0 acres Total of Prime and Unique Farmlands. Total Acreage of Statewide and Local Important Farmlands impacted by Alternative G is 139.0. Alternative G would convert 0.17% of Laurel County farmland to non-agricultural use. Finally, there was 69% of Farmland in the local government jurisdiction with the same, or higher, relative Value. In Part V of AD-1006, Alternative G scored 750 on a scale 0-100. In Part VI of Form AD-1006, Alternative G scored 75, of a possible high of 160. The scores of Part V and Part VI were combined for a Total of 150 points. Therefore, mitigation for impacts to area farmlands associated with Alternative G would not be required.

Alternative H

For Part IV of Form AD-1006, Land Evaluation Information, Alternative H contained 96.0 acres Total of Prime and Unique Farmlands. Total Acreage of Statewide and Local Important Farmlands impacted by Alternative H is 101.0. Alternative H would convert 0.14% of Laurel County farmland to non-agricultural use. Finally, there was 46% of Farmland in the local government jurisdiction with the same, or higher, relative Value. In Part V of AD-1006, Alternative H scored 79 on a scale 0-100. In Part VI of Form AD-1006 Alternative H scored 75 of a possible high of 160. The scores of Part V and Part VI were combined for a Total of 154 points. Therefore, mitigation for impacts to area farmlands associated with Alternative H would not be required.

Alternative I

For Part IV of Form AD-1006, Land Evaluation Information, Alternative I contained 77.0 acres Total of Prime and Unique Farmlands. Total Acreage of Statewide and Local Important Farmlands impacted by Alternative I is 117.0. Alternative I would convert 0.18% of Laurel County farmland to non-agricultural use. Finally, there was 46.0% of Farmland in the local government jurisdiction with the same, or higher, relative Value. In Part V of AD-1006, Alternative I scored 79 on a scale 0-100. In Part VI of Form AD-1006, Alternative I scored 75 of a possible high of 160. The scores of Part V and Part VI were combined for a Total of 154 points. Therefore, mitigation for impacts to area farmlands associated with Alternative I would not be required.

Alternative L

For Part IV of Form AD-1006, Land Evaluation Information, Alternative L contained 104.0 acres Total of Prime and Unique Farmlands. Total Acreage of Statewide and Local Important Farmlands impacted by Alternative L is 138.0. Alternative L would convert 0.18% of Laurel County farmland to non-agricultural use. Finally, there was 46.0% of Farmland in the local government jurisdiction with the same, or higher, relative Value. In Part V of AD-1006, Alternative L scored 79.0 on a scale 0-100. In Part VI of Form AD-1006 Alternative L scored 75 of a possible high of 160. The scores of Part V and Part VI were combined for a Total of 154 points. Therefore, mitigation for impacts to area farmlands associated with Alternative L would not be required.

Table 5.2.58-1 - Land Evaluation criteria and Site Assessment criteria (LESA) Scores per Alternative

Alternative	Pulaski Score	Laurel Score
B	114.2	-
K	96.6	-
D	103.7	-
B-D	98.4	-
G	-	145
H	-	149
I	-	149
L	-	149
M	-	149

Alternative M

For Part IV of Form AD-1006, Land Evaluation Information, Alternative M contained 81.0 acres Total of Prime and Unique Farmlands. Total Acreage of Statewide and Local Important Farmlands impacted by Alternative M is 134.0. Alternative M would convert 0.16% of Laurel County farmland to non-agricultural use. Finally, there was 46.0% of Farmland in the local government jurisdiction with the same, or higher, relative Value. In Part V of AD-1006, Alternative M scored 79.0 on a scale 0-100. In Part VI of Form AD-1006, Alternative B scored 75 of a possible high of 160. The scores of Part V and Part VI were combined for a Total of 154 points. Therefore, mitigation for impacts to area farmlands associated with Alternative M would not be required.

Table 5.2.58-1 summarizes and compares the proposed Build Alternatives Scores for impacts to project area farmlands. Total prime farmland impacts, by alternative are given in Table 3.2.5-1.

5.2.59 Impacts to Parks and Recreational Facilities

It is national policy to make special effort to preserve public parks and recreation lands, wildlife and waterfowl refuges, and historic sites. In the Transportation Act of 1966, a special provision provides protection to these resources. This provision, known as Section 4(f), stipulates that the Federal Highway Administration (FHWA) will not approve any program or project, which requires the use of any publicly owned park, recreation area, or wildlife/waterfowl refuge, or any land from an historic site of national, state, or local significance, unless: (1) there is no feasible and prudent alternative to the use, and (2) all possible planning to minimize harm resulting from such use is included.

It appears that the construction of I-66 Somerset to London, Kentucky has the potential for impacts to Section 4(f) resources present within the immediate project area. These potential impacts would involve the Sheltowee Trace National Recreation Trail, the Shopville City Park and the Rockcastle River. The Rockcastle River has been designated as a state Wild River, and has been nominated as a national Wild and Scenic River. Due to its eligibility to attain national status, this river would be considered a Section 4(f) impact. If avoidances of impacting the Rockcastle River, the Shopville City Park or the Sheltowee Trace National Recreation Trail are not possible, the Project Team will provide information for the determination whether or not the alternative is feasible and prudent.

Alternatives KY 80 Modified and KY 80 Shifted would impact the entire Shopville City Park See (Figure 5.2.59-1 in Appendix C). The Governor's Office for Local Development (GOLD), which is the State Liaison Agency for the Department of Interior, National Park Service (NPS), was contacted, and it has been determined that the Pulaski County Fiscal Court has applied for a Land and Water Conservation (LWCF) grant to provide enhancements for this park. The LWCF program provides matching grants to state and local governments for the acquisition and development of public outdoor recreation areas and facilities. The program is intended to create and maintain a nationwide legacy of high quality recreation areas and facilities, and to stimulate non-federal investments in the protection and maintenance of recreation resources across the United States.

If the KY 80 Shifted alternative is selected, Section 6(f) involvement will be necessary. Section 6(f) requires that all LWCF funded property be replaced with property of similar use and in reasonable proximity to the impacted property. NPS will consider conversion requests if all practical alternatives to the proposed conversion have been evaluated, if fair market values (appraisals) of the affected property and its identified replacement property have been conducted, and if the proposed replacement property is of reasonable equivalent usefulness and location. If Alternative KY 80 Shifted is selected as the Build Alternative, KYTC right of way agents will work with GOLD and the Pulaski County Fiscal Court to identify, appraise and purchase the appropriate replacement property for the Shopville City Park.

5.2.60 Hazardous Materials Findings and Recommended Actions

A Phase I Environmental Site Assessment (ESA) technical report was conducted in accordance with the scope and limiting conditions set forth in the American Society for Testing and Materials (ASTM) practice 1527. Recognized Environmental Conditions (RECs) were identified for properties within, or adjacent to, the proposed right-of-way limits of the Build Alternatives under consideration.

The goal of this Assessment was to determine the potential presence of aboveground and/or underground storage tanks, hazardous wastes or materials, solid and special wastes and areas of potential hazardous waste concerns which may pose a threat to human health and/or the environment. The results of the Phase I ESA were utilized to determine the need for Phase II Site Assessments.

There are a total of eleven proposed alternatives extending from Somerset to London, Kentucky. Of the eleven proposed alignments, two generally follow the existing KY 80 corridor and nine are on a new location.

All eleven proposed alternatives had sites that were investigated for the presence of RECs. After careful research and consideration of each of the site's individual characteristics, several of these sites have been recommended for additional work, should a build alternative be selected as the Preferred Alternative. There are nine alternatives that impact sites recommended for additional work. Two proposed alternatives, D and I, do not impact any sites recommended for further study. Please refer to the summary table 5.2.60-1 for a breakdown of the proposed build alternatives, their associated sites and Phase II recommendations (Phase II – Individual site sampling with physical and chemical analyses that conform to EPA sampling analysis protocols).

For additional survey details, reference the Hazardous Materials and Underground Storage Take Baseline Report (October 2004).

Table 5.2.60-1 Hazardous Materials Site Impact Summary

Alternative	Impacted Sites Not Recommended for Phase II Work	Impacted Sites Recommended for Phase II Work	Total Sites Recommended for Phase II Work
B	Imperial Concrete	Mink's Auto Sales, Hansen Laurel Quarry	2
D	None	None	0
B-D	Imperial Concrete	Mink's Auto Sales, Hansen Laurel Quarry	2
K	Imperial Concrete	Mink's Auto Sales, Hansen Laurel Quarry	2
KY 80 Shifted	Pulaski Steel and Todd's Truss Company, Wades Auto Sales, Shopville Elementary School, Utility substation, J & M Discount, Imperial Concrete	JC's Deli, Buie's Wrecking Service, Mink's Auto Sales, Hansen Laurel Quarry	4
KY 80 Modified	Pulaski Steel and Todd's Truss Company, Wades Auto Sales, Shopville Elementary School, Utility substation, J& M Discount, Imperial Concrete	Buie's Wrecking Service, JC's Deli, Mink's Auto Sales, Hansen Laurel Quarry	4
G	Farm Implement Storage	Tony's Bait and Tackle, Sawmill Equipment Storage, B & T Truck Parts, Field's Truck Repair, Salvage Yard on Hickory Road, Salvage Yard on Tabor Road	6
H	None	Fields Truck Repair	1
I	None	None	0
L	None	Sawmill / Heavy Equipment Storage, B & T Truck Parts, Fields Truck Repair, Salvage Yard on Hickory Road, Savage Yard on Tabor Road	5
M	None	Tony's Bait and Tackle, Sawmill / Equipment Storage, B & T Truck Parts, Fields Truck Repair Salvage Yard on Hickory Road, Savage Yard on Tabor Road	6

Individual Hazardous Materials Site Descriptions for Sites Recommended for Phase II Testing

B&T Truck Parts
B & T Truck Parts is located at 7455 Russell Dyche Highway just off of Highway 80. This site would be impacted by Alternate H and Alternate I. An on-site inspection of the property revealed surface staining, vegetation distress, a strong petroleum odor and erosion problems. In addition, there was also evidence of excavations and filling on the property. The site consists of salvage operations only. An interview with the owner indicated that the property has been in its current use for approximately 17 years. The owner indicated that the property does not have any underground or aboveground storage tanks.
The owner further indicated that used oil is stored on site, but is pumped out by a qualified vendor. The owner stated that water for the property and the business is obtained from a creek that flows adjacent to the property. A sump pump is used to bring water out of the creek and onto the property. The owner knew of no water wells on the property.

A check of the Kentucky Geological Survey website that contains a groundwater database did not reveal the presence of any domestic or industrial water supply wells, or springs on the subject property.

Build Alternatives M, L and G potentially impact this site. In the event any of these alignments are selected as the Preferred Alternative, Limited Phase II testing is recommended for this location to help determine the presence/absence of hazardous materials. Should this site tests positive for hazardous substances, full Phase II testing would be warranted to characterize the extent of any potential contamination.

Tony's Bait & Tackle
Tony's Bait & Tackle is located at 2542 W. Laurel Road, London, Kentucky. This site has a total of three (3) active USTs; one (1) – 4,000 gallon gasoline tank (installed 1978), one (1) – 2,000 gallon kerosene tank (installed 1978) and one (1) 10,000 gallon gasoline tank (installed 1983). The tanks are constructed of single wall steel. External tank protection consists of automatic tank gauging. Flow restrictors have been installed for tank overfills protection. The single wall steel piping is pressurized and has impressed current-cathode protection. A check of the Kentucky Geological Survey website that contains a groundwater database and mapping did not reveal the presence of any domestic or industrial water supply wells, monitoring wells or springs on the subject property. A telephone interview with Chief Gregg Lewis of the Laurel County Fire Department confirmed that the last known commercial use of the property was a service station. In addition, a telephone interview with Mr. Brian Bell of the Laurel County health department did not reveal any known environmental or health concerns with the property.

This site is potentially impacted by the common alignments of Alternatives G and M. In the event either of these alignments is chosen as the Preferred Alternative, Limited Phase II testing is recommended to determine the presence/absence of potential contamination resulting from the current use of the site.

Fields Truck Repair
Fields Truck Repair is located at the corner of Willie Green Road and Kentucky Route 192. An on-site inspection revealed two 250 gallon tanks and 55 gallon drums used to store used oil and spent solvents. These used chemicals are disposed of through Bennett Oil Company. An interview with an employee revealed no other underground or aboveground tanks. In addition to the above-mentioned oil and solvents, other substances in smaller amounts typically used for the repair of trucks were located inside of the facility. Stains on the ground and odors where also observed. Surface Stains and a petroleum odor were noted during the field visit. According to the employee interviewed, the property has been used as a truck repair facility for 5 or 6 years. Prior to that time the property may have been a body shop. The employee further stated that the facility is supplied water by the city water system, and he knew of no water wells on-site.

This site is potentially impacted by the common alignments of Alternatives G and M and H and L. In the event either of these alignments is chosen as the Preferred Alternative, Limited Phase II testing is recommended to determine the presence/absence of potential contamination resulting from the current use of the site.

Sawmill/Heavy Equipment Storage
This site (seen in figure 5.2.60-1) is located along Vaughn Road. Parking area, Surface Staining and Distressed Vegetation where observed on the property. An Aboveground Storage Tank was also observed on the property. The tank appears to be an active tank with no containment (see photo). In addition, during the field investigation it was noted that the ground around the tank was stained and the area has an odor of oil and fuel. A check of the Kentucky Geological Survey website that contains a groundwater database and mapping did not reveal the presence of any domestic or industrial water supply wells, monitoring wells or springs on the subject property.

Build Alternatives M, L and G potentially impact this site. In the event any if these alignments are selected as the Preferred Alternative, Limited Phase II testing is recommended to help determine the presence/absence of hazardous materials. Should this site tests positive for hazardous substances, full Phase II testing would be warranted to characterize the extent of any potential contamination.

Salvage Yard on Hickory Road
The property surrounding the junkyard is rural and rural residential. An on-site inspection of the property revealed erosion and as well as signs of vegetation distress. In addition, a creek that borders the property area collects runoff from these areas of concern. A check of the Kentucky Geological Survey website that contains a groundwater database and mapping did not reveal the presence of any domestic or industrial water supply wells, monitoring wells or springs on the subject property.

Build Alternatives M, L and G potentially impact this site. In the event any of these alignments is selected as the Preferred Alternative, Limited Phase II testing is recommended to help determine the presence/absence of hazardous materials. Should this site tests positive for hazardous substances, full Phase II testing would be warranted to characterize the extent of any potential contamination.

Salvage Yard on Tabor Road
The property surrounding the junkyard is rural and rural residential. An on-site inspection of the property revealed surface staining, vegetation distress, and a strong petroleum odor. In addition, a creek that borders the property area collects runoff from these areas of concern. A check of the Kentucky Geological Survey website that contains a groundwater database and mapping did not reveal the presence of any domestic or industrial water supply wells, monitoring wells or springs on the subject property.

Build Alternatives M, L and G potentially impact this site. In the event any of these alignments is selected as the Preferred Alternative, Limited Phase II testing is recommended to help determine the presence/absence of hazardous materials. Should this site tests positive for hazardous substances, full Phase II testing would be warranted to characterize the extent of any potential contamination.

Figure 5.2.60-1 – Example Hazardous Materials Site - Sawmill/Heavy Equipment Storage; Impacted by Alternatives G, L and M and Recommended for Phase II

Minks Auto Sales
Minks Auto Sales is located at 236 Sears Cemetery Road off of Highway 80 near Somerset. An on-site interview was conducted on September 22, 2004 to inspect the property and interview the property owner. The property is currently being used as a used car lot. The business owner indicated that there are no underground storage tanks or aboveground storage tanks on the property. The property has been used to sell cars since 2000. Before 2000 the property was used for a farm. The water for the property is supplied by gravity fed springs.

A telephone interview with Tiger Robinson, the Pulaski County Public Safety Director and with Jonathan Dye of the Pulaski County Health Department did not reveal any known environmental or health concerns with the property.

Build Alternatives KY 80 Shifted potentially impacts this site. In the event any of this alignment is selected as the Preferred Alternative, Limited Phase II testing is recommended for this location to help determine the presence/absence of hazardous materials. In the event this site tests positive for hazardous substances, full Phase II testing would be warranted to characterize the extent of any potential contamination.

The Hanson Laurel Quarry
The Hanson Laurel Quarry is located at 13670 East Highway 80 near Somerset. An interview with the plant supervisor indicated that the property has been used as a quarry since 1983. Prior to 1983 the property was used as farmland. Used oil is stored on site in 1,000-gallon tanks. The oil is picked up and disposed of off-site. PCB electrical equipment has been on site to run the quarry as long as the quarry has been in operation. The supervisor further stated that the plant is not on city water but instead uses a water tank for water and water supply. An on-site tour of the facility was not conducted due to the operations being carried out at the time of the site visit.

A telephone interview with Tiger Robinson, the Pulaski County Public Safety Director and with Jonathan Dye of the Pulaski County Health Department did not reveal any known environmental or health concerns with the property. Build Alternatives B, and B-D bisect the quarry, while KY 80 Modified and KY 80 Shifted have frontage impacts to the site. Due to the oil storage onsite and the possible presence of PCB containing equipment, limited Phase II testing is recommended for this location to help determine the presence/absence of hazardous materials. In the event this site tests positive for hazardous substances, full Phase II testing would be warranted to characterize the extent of any potential contamination.

Buie's Wrecking
Buie's wrecking is located near the corner of Highway 80 and Highway 431. An on-site visit was conducted in February of 2004. The property is currently used as a salvage yard. Stained soil and distressed vegetation were observed during the site visit. A creek borders the property to the east.
A telephone interview with Tiger Robinson, the Pulaski County Public Safety Director and with Jonathan Dye of the Pulaski County Health Department did not reveal any known environmental or health concerns with the property.

Build Alternatives KY 80 Modified and KY 80 Shifted potentially impact this site. In the event either of these alignments is selected as the Preferred Alternative, Limited Phase II testing is recommended for this location to help determine the presence/absence of hazardous materials. In the event this site tests positive for hazardous substances, full Phase II testing would be warranted to characterize the extent of any potential contamination.

JC's Deli & Grocery
JC's Deli & Grocery is located at 8765 East Highway 80 near Somerset. This site has a total of four (4) active UST's; two (2) 6,000 gallon gasoline tanks, one (1) 10,000 gasoline tank, and one (1) 1,000 diesel tank. During an on-site interview the owner indicated that the tanks have been properly tested and are currently in compliance. The owner further indicated that he was not aware of any leaks or other problems with the tanks or property. The property has been used as a service station since 1975. Before that time the property was raw land.

A telephone interview with Tiger Robinson, the Pulaski County Public Safety Director and with Jonathan Dye of the Pulaski County Health Department did not reveal any known environmental or health concerns with the property.

Build Alternatives KY 80 Modified and KY 80 Shifted potentially impact this site. In the event either of these proposed alignments is chosen as the Preferred Alternative, Limited Phase II testing is recommended to determine the presence/absence of potential contamination resulting from its current use.

The locations for the previously discussed hazardous materials sites can be seen on figure 5.2.60-1 in Appendix C.

- The goal of a Phase I Environmental Site Assessment (ESA) is to determine the potential presence of aboveground and/or underground storage tanks, hazardous wastes or materials, solid and special wastes and areas of potential hazardous waste concerns. The results of the Phase I ESA were utilized to determine the need for Phase II testing (physical and chemical sampling and analysis).
- Nine of the alternatives impact Hazardous Materials sites, Alternatives D & I do not impact any sites.
- Of the alternatives that impact sites *and* recommend additional (phase II) testing, the minimum number of sites is one (1) , Alternative H, and the maximum is six (6), Alternative G.

5.2.61 Air Quality Impacts

Air Quality Regions and Conformity

The project area is part of the Appalachian Intrastate Air Quality Control Region and the South Central Kentucky Intrastate Air Quality Control Region. The project area is not located within a Metropolitan Planning Organization (MPO) jurisdiction and therefore inclusion in air quality conformity analyses occurs only in the Statewide Transportation Improvement Plan (STIP) (see Section 4.2.16 for more conformity information).

Project Area Air Quality

Pulaski, Laurel and Rockcastle counties do not have non-attainment designations for any of the EPA criteria air pollutants, which include: Carbon Monoxide (CO), Nitrogen Dioxide (NO_2), One-Hour and Eight-Hour Ozone (O_3), Sulfur Dioxide (SO_2), Particulate Matter (<2.5 micrometers (um) and <10um in size) and Lead (Pb). The only criteria pollutant modeled on a project level basis is CO. Transportation project related Carbon Monoxide is generated from the incomplete burning of fuel in automotive engines. The effects of CO are localized and attributable to tailpipe emissions, intensified by vehicles lining up at traffic signals.

Microscale CO Analysis

Highway configurations are represented in the CAL3QHC models as a series of line links (roadway segments that define the travel lanes) plotted on a Cartesian coordinate system (numbers that locate a point in space, defining a position and measurable distance). The existing KY 80/I-75 interchange had the highest traffic volumes of signalized intersections within the project area and was utilized to generate worst-case carbon monoxide levels for future traffic numbers (design year traffic supplied by Wilbur Smith and Associates). More detailed methodology, including model runs and traffic projections, refer to the Air Quality Baseline Report (November 2004).

The CAL3QHC model calculates one-hour carbon monoxide concentrations, solely for transportation sources. This concentration is added to the background concentration of 2.0 ppm (parts per million), to give the total concentration. Eight-hour concentrations are calculated by subtracting the one-hour background concentration of 2.0 ppm from the total one-hour concentration, then multiplying this quantity by a persistence factor of 0.7 (to account for CO remaining after dispersion [dilution]). The background concentration is added to this result to arrive at the total eight-hour concentration.

Project Related Maximum Concentrations

Project maximum concentrations are given at the single receptor (of the 18 free-flow and 36 interchange receptors) that had the highest predicted CO value for each of the Existing, No Build and Build Scenarios. Where multiple receptors had the same value that was the maximum for that scenario, a single receptor is not cited.

Existing Free Flow
The calculated maximum one-hour concentration for 2004 is 3.7 ppm at multiple receptors.
The calculated maximum eight-hour concentration for 2004 is 3.2 ppm at multiple receptors.

Existing I75/KY 80 Interchange
The calculated maximum one-hour concentration for 2004 is 5.0 ppm at receptor 14.
The calculated maximum eight-hour concentration for 2004 is 4.1 ppm at receptor 14.

No-Build Free Flow
The calculated maximum one-hour concentration for no-build alternate is 3.0 ppm at multiple receptors.
The calculated maximum eight-hour concentration for no-build alternate is 2.7 ppm at multiple receptors.

No-Build I75/KY 80 Interchange
The calculated maximum one-hour concentration for no-build alternate is 4.4 ppm at multiple receptors.
The calculated maximum eight-hour concentration for no-build alternate is 3.7 ppm at multiple receptors.

Design Year Free Flow
The calculated maximum one-hour concentration for the build alternative is 3.0 ppm at multiple receptors.
The calculated maximum eight-hour concentration for the build alternative is 2.7 ppm at multiple receptors.

Design Year I75/KY 80 Interchange
The calculated maximum one-hour concentration for the build alternative is 4.6 ppm at multiple receptors.
The calculated maximum eight-hour concentration for the build alternative is 3.8 ppm at multiple receptors.

The project one-hour and eight-hour maximum concentrations (in ppm) are given in Table 5.2.61-1. For each model type (Free-flow and Interchange) the maximum one hour and eight concentrations are given for the existing, no build and build scenarios. For each maximum concentration, the model reports a receptor having the maximum value (though there may be multiple) and the wind angle at which that maximum occurred.

Project Related Air Quality Conclusions

Pulaski and Laurel counties are currently in attainment for the transportation related air pollutants. According to the calculated existing and future emissions of CO, the proposed project is not expected to alter the counties' attainment status or add to the pollutant burden of the Appalachian Intrastate or South Central Kentucky Air Quality Control Regions.

All existing and predicted carbon monoxide concentrations are below the one-hour standard of 35 ppm and the eight-hour standard of 9 ppm. For Pulaski, Laurel and Rockcastle counties transportation control measures are not required pursuant to the Amended Final Conformity Guidelines, September 15, 1997.

Design-year traffic projections for the individual build alternatives do not exceed those utilized in this analysis for the KY 80 corridor and therefore the future free-flow carbon monoxide concentrations would not exceed those modeled in this study. The proposed I-66, Somerset to London, facility would not cause any violation of the National Ambient Air Quality Standards.

Table 5.2.61-1 Project Related Maximum One-Hour and Eight Hour Carbon Monoxide Concentrations (in ppm)

Scenario	KY 80 Free Flow Maximum [CO] (in ppm)	Receptor	Wind Angle (in degrees)	I-75/KY 80 Interchange Maximum [CO] (in ppm)	Receptor	Wind Angle (in degrees)
One Hour Maximums						
Existing	3.7	6	100	5.0	14	320
No Build	3.0	3	110	4.4	15	320
Build	3.0	3	310	4.6	15	320
Eight Hour Maximums						
Existing	3.2	6	100	4.1	14	320
No Build	2.7	3	110	3.7	15	320
Build	2.7	3	310	3.8	15	320

- Air Quality Modeling is utilized to predict the potential for health and safety concerns from potentially elevated Carbon Monoxide (CO) levels generated from internal combustion engines in trucks and automobiles traveling in the project corridor.
- Acceptable pollutant levels are established by the EPA and are referred to as National Ambient Air Quality Standards (NAAQS). The NAAQS for CO is 35ppm (parts per million) for one-hour concentrations and 9ppm for eight-hour concentrations
- According to the calculated existing and future emissions of CO, the proposed project is not expected to alter the counties' attainment status or add to the pollutant burden of the Appalachian Intrastate or South Central *Kentucky Air Quality Control Regions.*

5.2.62 Construction Related Air Quality Impacts and Mitigation

The construction phase of the proposed project has the potential of temporarily impacting ambient air quality due to emissions from construction equipment and fugitive dust from construction activities. Fugitive dust (particulate matter) typically has the greatest impact. This impact would occur in association with excavation and earthwork; cement, asphalt, aggregate handling; heavy equipment operation; use of unpaved haul roads; and wind erosion of exposed areas and material storage piles. These air quality effects would be temporary and would vary in scale depending on the type and number of equipment, local weather conditions, the degree of construction activity, and the nature of the construction activity.

Measures will be taken to reduce fugitive dust and other emissions generated during construction. Construction activities would be performed in a manner that controls emissions from occurring as the result of burning (where allowed), drilling, blasting, production of materials, hauling, or any other necessary construction operations of any kind. Air pollution associated with dust can be effectively controlled through the use of watering, the application of calcium chloride, or other techniques in accordance with KYTC specifications.

Watering work areas to increase moisture and reduce dust will control air pollutants generated by construction activities. Contract specifications will dictate that all drilling, grinding, and sawing of rock, shale, concrete, and other similar dust-producing materials be performed with equipment provided with water sprays, fabric-filtered collection systems, or other suitable devices to prevent excessive dust from becoming airborne.

Emissions from construction equipment will be controlled in accordance with emission standards prescribed under state and federal regulations. Equipment shall be maintained in proper mechanical condition with exhaust equipment in place.

No burning of construction wastes will be performed without the proper variance from the Kentucky Natural Resources and Environmental Protection Cabinet (KNREPC). All burning would be conducted in accordance with applicable laws, ordinances, rules and regulations.

5.2.63 Noise Impact and Abatement Criteria

In accordance with 23 CFR Part 772, the Federal Highway Administration (FHWA) Noise Abatement Criteria (NAC) of 67 dBA Leq for residential structures and 72 dBA Leq for commercial structures, is approached (within one dBA Leq), equaled or exceeded at the receivers indicated for the build alternative listed in Table 5.2.63-1 in Appendix C.

Table 5.2.63-1 categorizes impacts to the receivers in accordance with policies outlined in the Kentucky Transportation Cabinet's Noise Abatement Policy as follows:

Kentucky guidelines identify impacts based on the following criteria:

Category 1 (≥10 dBA Leq over existing levels; within 1 dBA Leq or exceeds the NAC);
Category 2 (<10 dBA Leq over existing levels; within 1 dBA Leq or exceeds the NAC);
Category 3 (≥10 dBA Leq over existing levels; between 60-65 dBA Leq);
Category 4 (≥10 dBA Leq over existing levels; less than 60 dBA Leq)

The Kentucky guidelines identify receivers as impacted if the NAC is approached by 1 dBA Leq or exceeded. The Kentucky policy designates a receiver as impacted if exceeding the existing level by 10 dBA Leq.

Determining the reasonableness of noise barriers involves several factors including:

- Severity of Impact
- Number of People Effected
- Cost of Barriers
- Structural Feasibility of the Barriers
- Views of Impacted Residents

A cost-effectiveness analysis is conducted to ascertain the feasibility/reasonableness of barrier abatement for impacted receivers at which it has been determined that further study is necessary. A cost-effectiveness study for barrier abatement will be performed on the preferred alternative if a build alternative is selected. There are conditions in which barrier construction is generally not considered reasonable and include:

- Along existing roadways where the proposed project does not appreciably alter (>3dBA) future noise levels.
- At locations where site characteristics prohibit a reasonable wall dimensions that allow substantial reduction (5 dBA or greater) in noise levels.
- Cost-effectiveness analyses yield a low priority for noise abatement considerations (unless site specific special considerations create overriding circumstance).
- At locations where the barrier would pose overriding safety and maintenance problems.
- At locations where after citizen involvement it is obvious that the majority of the affected public is opposed the wall.

The abatement tables (table 5.2.63-1 in Appendix C) summarize the noise analysis for the modeled receivers and indicate impacts and barrier abatement considerations. Abatement considerations serve as a guideline to establish the likeliness of further barrier reasonableness studies if the given alternative is carried forward for further analysis. The abatement considerations are assigned a letter code based on the likeliness of further analysis. The designations in Table 5.2.63-1 are as follows:

A) Possible barrier location for which a cost-effectiveness analysis is necessary to determine reasonableness of barrier abatement if the build alternative is selected.
B) Proposed project does not appreciably alter (>3dBA) future noise levels and therefore barrier abatement is generally considered unreasonable.
C) Isolated receiver for which cost-effectiveness generally makes barrier abatement infeasible.

5.2.64 Project Related Noise Impacts and Future Abatement Investigation Summary

The abatement tables (table 5.2.63-1 in Appendix C) show the receivers and their existing, no-build and build noise levels for the alternatives as well as their NAC value and category. The final column tries to describe the likeliness of barrier abatement for those receivers that are impacted by the given alternative. The designation "A" indicates that an impact is present that needs to be further investigated for the feasibility/reasonableness of barrier abatement. Those receivers with a designation of "A" will be analyzed further if a build alternative is chosen as the preferred alternative. The analysis will include but is not limited to: cost-effectiveness analysis, safety assessment, on-site analysis, and public involvement. Impacts with a designation of "B" are those that do not appreciably alter future noise levels and barrier abatement is generally not considered reasonable. Those impacted receivers falling in category "B" generally represent those receivers that are in proximity to existing facilities, whose noise level is dependant on existing transportation infrastructure and therefore project related build facilities do not significantly increase future noise levels in relation to the no-build. These receivers, due to the limited noise attenuation relative to the no-build, generally do not meet cost-effectiveness criteria. Impacts with a designation of "C" are isolated receivers, for which barrier abatement is generally considered infeasible. In addition to barrier analysis, abatement measures other than barriers will be investigated if a build alternative is chosen as the preferred alternative.

Noise Impact Matrix

The number of NAC impacts for each alternative combination; receptor impact NAC categorical classifications (severity of impact, grouped by most severe and less severity); and the number of impacted receivers that would require feasibility/reasonableness studies are presented in Table 5.2.64-1 on the following page.

For more detail regarding noise analyses, refer to the Highway Traffic Noise Impact Baseline Report (January 2005).

5.2.65 Noise Impact Analyses for Historic Properties

The methodology that was applied to assess highway traffic noise impacts was also utilized to assess the future noise levels at those properties that are listed on/or eligible for listing on the National Register of Historic Places. Existing noise levels were either measured in the field or modeled (if along existing KY 80, utilizing existing field measured traffic counts) for each of the 29 historic properties identified in Chapter 4. For each historic property within 1200 feet of a proposed alternative (limits of model validity), the results of the noise analysis were used to determine if the proposed project would adversely affect the historic properties. For a discussion of the effect of noise on historic properties, refer to section 5.4.3.

5.2.66 Future Noise Analyses

The project predicted noise levels contain traffic traveling the interstate facility from the western terminus, near Somerset, KY to the eastern terminus just east of I-75. The current noise analysis does not include interchange analyses. The residential areas in the vicinity of the interchange of I-66 with I-75 will require additional analysis if the preferred alternative includes a build scenario and upon the selection of an interchange design. The refined noise and abatement analysis will take into account mainline and ramp configurations and traffic.

If a build alternative is selected, the proposed project generated noise level analysis will be expanded and refined to include more detailed design information, including but not limited to: interchange configurations, detailed grade information, ground zones and terrain lines. In addition to the refined analyses; noise abatement measures, including barriers, will be evaluated for those receptors where the noise analysis determined the need for further study (see table 5.2.63-1 in Appendix C). The barrier analysis and further noise analysis will be included in the Final Environmental Impact Statement and in an addendum to the Highway Traffic Noise Impact baseline report.

5.2.67 Construction Noise

An increase in project area noise levels would occur during the construction of the proposed project. Land uses that would be sensitive to vehicular noise would also be sensitive to construction noise. The actual level of noise impact during this period, however, will be a function of the number and type of equipment being used, as well as the type of construction activities. This may include heavy equipment movement, pile driving for bridge supports, and grading.

Contract specifications will establish construction noise limits for sensitive areas. With regard to construction noise, the contractor shall be required to follow best management practices with regards to noise generating equipment and implement standard noise reducing measures. It is standard policy on Kentucky construction projects to require the contractor to use equipment and procedures to restrict construction noise in the vicinity of sensitive receptors such as schools, hospitals and churches.

Table 5.2.64-1 Highway Traffic Noise Impact, Severity and Representative Receiver Summary per Alternative Combination

Alternative	Number of Impacts	Number of Category 1 & 2 Impacts	Number of Category 3 & 4 Impacts	Number of Representative Receivers Impacted	Impacted Receivers Requiring Barrier Feasibility/Reasonableness Studies
Alternative B/G	24	13	11	152	17
Alternative B/H	23	11	12	163	16
Alternative B/I	27	10	17	175	20
Alternative B/L	23	11	12	155	16
Alternative B/M	25	11	14	152	18
Alternative D/G	26	14	12	156	19
Alternative D/H	25	12	13	167	18
Alternative D/I	29	11	18	179	22
Alternative D/L	25	12	13	159	18
Alternative D/M	27	12	15	156	20
Alternative B-D/G	28	16	12	160	19
Alternative B-D/H	27	14	13	171	18
Alternative B-D/I	31	13	18	183	22
Alternative B-D/L	27	14	13	163	18
Alternative B-D/M	29	14	15	160	20
Alternative K/G	31	17	14	188	25
Alternative K/H	30	15	15	199	24
Alternative K/I	34	14	20	211	28
Alternative K/L	30	15	15	191	24
Alternative K/M	32	15	17	188	26
Alternative KY80Mod/G	32	21	11	199	28
Alternative KY80Mod/H	31	19	12	210	27
Alternative KY80Mod/I	35	18	17	222	31
Alternative KY80Mod/L	31	19	12	202	27
Alternative KY80Mod/M	33	19	14	199	29
Alternative KY80Sft/G	26	15	11	180	21
Alternative KY80Sft/H	25	13	12	191	20
Alternative KY80Sft/I	29	12	17	203	24
Alternative KY80Sft/L	25	13	12	183	20
Alternative KY80Sft/M	27	13	14	180	22

Alternative Combination with Greatest Number - Alternative Combination with the Least Number -

5.2.68 Visual Impact – Viewer Group Exposure and Sensitivity; Visually Sensitive Resources

The project area existing landscape districts with descriptions of existing landscape character, visual resources and visual quality were discussed in section 4.2.18 of this document. The visual quality discussed in this chapter revolves around viewer group exposure and sensitivity within each landscape district and outlines some general visual mitigation techniques.

Once final alternative alignments are selected in the next phase of work, specific impacts associated with each of them can be addressed, evaluated and compared, since the visual resource assessment methodology is an iterative process that is intended to be flexible and adaptive. At that time additional work will be required to depict expected changes in visual resources through simulations or other methods; to meet with community members in order to evaluate viewer response to these changes; to generate additional design guidelines, mitigation strategies, and enhancement concepts; and to address other planning, design and construction management issues.

5.2.69 Viewer Group Exposure and Viewer Sensitivity Overview

Each landscape district or unit has distinct viewer groups that differ in their response to the project and its setting. Views both *from* the road as well as views *of* the road must be considered. Examples of viewer groups are travelers on the existing and proposed highways, or residents within the project viewshed. Their responses are affected by their exposure (*viewer exposure*) and their sensitivity (*viewer sensitivity*).

Viewer exposure is primarily based on the number of people viewing the project, but also considers the degree to which viewers are exposed to a view by their physical location, and the duration of the view. For example, a person slowly hiking next to a waterfall (higher viewer exposure) will generally be much more perceptive of the waterfall than a motorist who passes by more quickly, at a greater distance (lower viewer exposure).

Viewer sensitivity is the degree to which viewers are likely to be receptive to the visual details, character, and quality of the surrounding landscape. Two principle factors affect viewer sensitivity: *activity* and *awareness*. Activity relates to whether the viewer's activity encourages him or her to look at the landscape, or whether it distracts the viewer from the landscape. Awareness relates to how a viewer's position, past visual experience, and/or individual preconceptions and values affect their receptivity to visual character and visual quality. For example, recreational enthusiasts in an area who are seeking a wilderness experience in a natural setting will generally be more sensitive to any type of visual impact than would be commuters who may pass the same area on their way to work.

Viewer exposure and viewer sensitivity scales (i.e., high, moderate, or low) characterize the viewer groups within each landscape district. Viewer sensitivity can be based primarily on viewer activity. While viewer groups often vary in their sensitivity, that is the *degree* to which a visual impact is perceived, they rarely differ in their opinion as to whether a particular visual impact of a project is negative or positive.

5.2.70 Viewer Group Exposure and Sensitivity; Visually Sensitive Resources for Each Landscape District

Flat Lick Creek District

Viewer Group Exposure and Sensitivity

Highway travelers (commuters, commercial vehicle operators, tourists) along either KY 80 or the proposed I-66 constitute a major viewer group through this district. High speeds, and the need to watch the road, tend to reduce travelers' perception of the landscape to a series of forms, shapes, and color contrasts. Motorists will generally perceive the openness and the rolling character of the pastures, the mass and shape of the knobs, the curtains of vegetation along creeks, and the sparsely distributed buildings. Travelers will be moderately sensitive to large-scale disruptive or discordant elements in the landscape such as large cut or fill slopes, retaining walls or bridges.

Residents, who are dispersed throughout this mostly rural district, represent a small but sensitive viewer group. Residents of Shopville and Barnesburg, and others living close to KY 80, have a visual environment that is affected by the existing highway and by development. They will be moderately sensitive to visual elements in their vicinity associated with a new interstate highway—more pavement, fencing, lights, structures, etc. Residents located some distance away from KY 80 currently enjoy views of a predominately pastoral landscape. These residents would generally be highly sensitive to discordant features in the landscape if they will be visible from their homes and from the local roads they frequently travel. Churches, cemeteries, and schools are also places where viewers will be moderately sensitive to visible changes in the landscape.

Residents within the Big Spring Unit would most likely be significantly affected by construction of any of the proposed alignments. The introduction of a four-lane highway through the small-scale idyllic valley has the potential to dramatically alter its visual quality.

No major recreation areas or geologic features, areas that attract sensitive viewer groups and that could be considered visually sensitive resources, have been identified in the area. However, within the district there is one structure that is listed on the National Register of Historic Places, and several others that are eligible for listing.

Visually Sensitive Resources

- Small agricultural valley in Big Spring Unit
- Wooded Knobs

Site-specific visual resources: Due to its high scenic quality, the small valley in Big Spring Unit along East Coleman Road (approximately one-half mile north of Barnesburg, extending to the west from Pine Hill Road, #1317) can be considered a visually sensitive resource. Its small scale, pastoral qualities and the intactness of its historical character epitomize rural Kentucky hill country.

District-wide visual resources: The picturesque wooded knobs in the Flat Lick Creek District help to define the visual character of the district, and can also be considered visually sensitive resources. Any major clearings or cuts would be highly visible from many directions.

The Knobs District

Viewer Group Exposure and Sensitivity

KY 80 crosses only the northeast corner of the Knobs District and does not have an extensive impact on the district's visual quality. Travelers on the existing highway view only a portion of the scenic quality within the area. Highway travelers are a major transient viewer group in the district, and would likely be only moderately sensitive to large-scale obtrusive elements (cuts, fills, clearings) in the landscape resulting from the development of a new highway.

Residences in the Knobs District are situated mostly along two local roads, Heron Lane and State Route 692, both of which follow narrow valleys through the district. Residents enjoy views across rolling pastures, but the high knobs that border the valleys often attenuate distant views. Any of the proposed alternatives that diverge from the existing KY 80 corridor, if constructed, would disrupt vistas that some residents currently enjoy. Residents would be very sensitive to introduced visual elements in the valleys or on the knobs that are visible from their homes and from local roads. Terrain features, conversely, may also hide new alterations to the landscape from some viewers.

Spelunkers visiting Blowing Cave, and other caves near Buck Creek at the eastern edge of the district, would be highly sensitive to any visually harmful alterations in the landscape near cave openings. It appears that Camp Victory would not be visually affected by the construction of any of the proposed alignments.

Visually Sensitive Resources

- Upper half of Stewart Branch valley
- Wooded knobs and hillsides

Site-specific visual resources: The upper half of Stewart Branch valley, south and east of Grundy Road #692, is very scenic and relatively free from development, with the exception of Camp Victory, which is a church-related youth camp and retreat facility located at the head of the valley.

District-wide visual resources: The scenic wooded knobs and hillsides in the Knobs District help to define the visual character of the district, and can also be considered visually sensitive resources. Any major clearings or cuts would be highly visible from many directions.

Buck Creek District

Viewer Group Exposure and Sensitivity

Highway travelers are a major viewer group through the Buck Creek District, and while they may be slightly aware of crossing Buck Creek, they are unlikely to appreciate its beauty at highway speeds. Travelers through the district are more likely to be cognizant of the high rounded knobs and their unbroken woods, of pasture openings visible from the road, and of the occasional building in the landscape. Travelers will also be moderately sensitive to large-scale intrusive elements in the landscape such as large earthworks, clearings through woodlands, large structures, and commercial development near the highway.

Roughly one-third (25 to 30) of the district's residences are located along or near the existing KY 80.
The other two-thirds of the district's residences are dispersed along the few local roads that follow narrow valleys and ridgelines. With the exception of some residents near Buck Creek and along KY 80, only a few residents enjoy distant views; the hilly terrain and dense forest cover limit distant views for most residents.

Although residents living along or near KY 80 experience a visual environment impacted by a busy two-lane highway, they will be moderately sensitive to the visual change (added lanes, increased scale, earthwork) associated with a new four-lane interstate highway in the same corridor. Residents living along the narrow local roads away from the existing highway will be highly sensitive to visible alterations in the landscape that are close to their homes. Members of Pleasant Run Church and visitors to the small cemeteries scattered throughout the district will also be sensitive to any near-view changes in the landscape.

Natural resources like Buck Creek, Short Creek, and publicly accessible cave openings can be expected to attract a wide range of recreational enthusiasts and sightseers.
Recreation activities include hiking, paddling, swimming, fishing, and spelunking. Buck Creek, from KY 80 to the south, is a popular class II paddling route that meanders through scenic wooded hills, and passes rocky cliffs and several cave entrances. Recreational viewer groups will be very sensitive to significant visual changes or intrusive elements in the landscape that are within their view.
Visually Sensitive Resources

- Short Creek
- Blowing Cave
- Stab Cave
- The Boiling Pots
- Buck Creek and associated cliffs and caves
- Wooded hillsides

Site-specific visual resources: This District contains several visually sensitive resources: Short Creek and the "Boiling Pots," to the east of Buck Creek, are highly unique geologic and hydrologic phenomenona that are highly valued by the local, recreational, and scientific communities. Blowing Cave and Stab Cave are individually significant geologic resources and contribute to Buck Creek District's scientific, recreational and scenic value.

District-wide visual resources: Buck Creek, with its meandering course; steep wooded sides and rock cliffs, is highly valued for its scenic qualities and for the recreational potential that it offers. The wooded hillsides of the Buck Creek District contribute significantly to the district's visual character and are highly visible from many areas.

Price Valley District

Viewer Group Exposure and Sensitivity

Highway travelers will perceive the outline and mass of the ridges, the unbroken woodlands that cover them, the contrasting openness and colors of the valley bottoms, and the occasional house or barn. They will be somewhat sensitive to forest clearings on hills and ridges, to increased building development, and to large-scale cuts and fills that disrupt the shape of natural terrain features and the continuity of the forest.

Most of the residents in this district live in Burdine Valley, situated along Burdine Valley Road, or along the few narrow, twisting local roads that intersect it. Steep wooded slopes rising above long narrow pastures characterize residents' views of the surrounding landscape.

A smaller number of residents live in Price Valley at varying distances from existing KY 80. These residents look out over the valley, slightly wider than Burdine Valley, to steep wooded slopes that rise above the existing highway. Residents of both valleys would be very sensitive to visually disruptive elements on the valley bottoms or on the highly visible slopes that border them.

Visually Sensitive Resources

- Wooded hillsides and ravines

Site-specific visual resources: No site-specific resources or particular areas stand out significantly as visually sensitive resources in the Price Valley District.

District-wide visual resources: The highly visible wooded hillsides throughout Price
Valley and Burdine Valley, and the picturesque wooded ravines help to define the visual character of the district and add scenic value to the area. Any major clearings or cuts on the hillsides would most likely be highly visible from many locations.

Lacey Fork District

Viewer Group Exposure and Sensitivity

The existing KY 80 intersects with Old Highway 80 near where it crosses Lacey Fork. Old Highway 80 provides access to the town of Billows, the Rockcastle River and the historic Whitaker Farm (the farm is actually in the Rockcastle River District and is described more fully in that section). The variety of local residents, sightseers, paddlers, and other recreational enthusiasts who use Old Highway 80 would be sensitive to introduced discordant visual elements or changes in the landscape that are visible from the road.

Highway travelers constitute a major viewer group through Lacey Fork District. Travelers generally perceive the shape and outline of the hills and ridges, the uniform cover of the woodland vegetation, and the contrast of open fields. This viewer group would be perceptive of large-scale incongruities in the landscape such as large man-made structures, earthworks, and woodland clearings.

Approximately forty homes are widely spaced along three local roads in this district—Sandy Gap Road (which parallels Lacey Fork), Squib Ano Road, and Lower Line Road. Only three or four residences are located adjacent to KY 80. Other residences are situated in narrow valley bottoms on or near the base of high, wooded hillsides with varying amounts of cleared land around them. The majority of residents within the Lacey Fork District would be able to see alterations in the landscape that occur in the immediate vicinity of their homes or along local roads. Proposed alternative alignments for I-66 that diverge from the existing KY 80 corridor have the potential to severely impact a number of these residences as well as the visual quality of the adjacent hillsides.

Visually Sensitive Resources

- Wooded hillsides and ravines

While the wooded hillsides and ravines in this district are beautiful and scenic, no particular places or resources have characteristics that justify designating them as visually sensitive resources.

Site-specific visual resources: No site-specific resources or particular areas stand out significantly as visually sensitive resources in the Lacey Fork District.

District-wide visual resources: The highly visible wooded hillsides throughout the Lacey Fork District and the picturesque wooded ravines help to define the visual character of the district and add scenic value to the area. Any major clearings or cuts on the hillsides would most likely be highly visible from many locations.

Rockcastle River District

Viewer Group Exposure and Sensitivity

Highway travelers are a fairly large viewer group through the Rockcastle River District; they are generally aware of the long descents and ascents approaching and leaving the bridge, the wide chasm and high ridges associated with the Rockcastle River, the uniform forest cover, and the swath that has been cut through the forest and land for the existing highway. They will be moderately sensitive to large-scale cuts and fills, vegetation clearings, and man-made structures (interchanges) and developments.

Few people reside in the Rockcastle River District, but proposed I-66 alternative alignments that diverge from

the existing KY 80 corridor, as well as associated ramps and interchanges, have the potential to severely impact several properties as well as the visual quality of the adjacent hillsides.

A significant viewer group in the district is composed of outdoor enthusiasts and recreational enthusiasts engaged in various activities including canoeing, rafting, fishing, hunting, camping, and rock climbing. These activities are concentrated on or near the Rockcastle River, but hikers, rock climbers, campers, and hunters traverse upland areas above the river as well. Another viewer group is composed of individuals participating in more passive forms of recreation such as sightseeing, bird watching, nature walks, visiting historic sites, etc.

Both active and passive recreational viewer groups will be highly sensitive to visually harmful man-made elements in the landscape such as structures, earthworks, clearings, and roads. The proposed I-66 alignment is required to cross the Rockcastle River in the vicinity of the existing KY 80 Bridge. Nonetheless, careful consideration will be required in the design of the new interstate and bridge structure to minimize visual impacts; these new structures will be very visible to highly sensitive recreational viewer groups.

Visually Sensitive Resources

- Historic Whitaker Farm (eligible for listing on the National Register of Historic Places)
- Little Clifty Creek
- Rockcastle River (designated a National Wild and Scenic River)
- Clifflines and Rock houses on both sides of the Rockcastle River
- Wooded hillsides

Site-specific visual resources: The historic Whitaker Farm, on the west side of the river just north of the existing KY 80 bridge, can be designated a visually sensitive resource due to its historic significance, scenic setting, and its popularity among local residents and tourists. The Little Clifty Creek Valley is also a visually stunning area with many scenic qualities.

District-wide visual resources: The Rockcastle River, designated a National Wild and Scenic River through this area, and the clifflines, rockhouses, and tall, wooded hillsides that face the river are highly valued for their outstanding scenic qualities.

Pine Creek District

Viewer Group Exposure and Sensitivity

Highway travelers are a major viewer group through the Pine Creek District, but this group has little opportunity to take in the scenic qualities of the District. They may get a glimpse of the Pine Creek gorge from the highway, but high roadside embankments and vegetation obstruct views elsewhere along the road. Motorists through this district will nonetheless be moderately sensitive to large-scale forest clearings, massive earthworks, and any large interchange structures or other built elements that would be visible from the road.

Most of the residences in this district occupy the area to the north of KY 80 and would most likely not be significantly affected by the construction of any of the proposed alignments. The degree to which the views of the few residents that live to the south of KY 80 would be impacted varies widely, depending upon which, if any, of the alternative alignments is constructed.

Like the Rockcastle River District, an important viewer group in Pine Creek District is made up of recreational enthusiasts. Hikers, backpackers, bicyclists, and horseback riders traverse the district along the Sheltowee Trace, while hikers, campers, fishers, and hunters frequent other areas within the district. Individuals within this viewer group are pursuing activities in a very natural and undisturbed setting at a pace that allows a high level of environmental perception and awareness. Visually obtrusive or discordant man-made elements in the landscape will be readily perceived by this viewer group, and have the potential to disrupt the recreational experience and enjoyment being sought. Particular attention may need to be given to the design of any highway lighting that might be required at potential interchange locations near the Trace. Careful planning will be required in order to preserve the natural quality of the Pine Creek District, and to make certain that the construction of I-66, and required interchanges, do not significantly alter the experience of groups and individuals seeking seclusion and tranquility in a natural setting.

Visually Sensitive Resources

- Pine Creek gorge
- Angel Hollow
- Sheltowee Trace
- Wooded hillsides and ravines

Site-specific visual resources: Angel Hollow, to the north of existing KY 80, is popular with hikers and bikers, has historical significance, and contains relatively undisturbed forest growth, some of which is more than one hundred years old.

Winding across the Pine Creek District, the Sheltowee Trace, a historic trail that follows a route used by Daniel Boone, is used today by hikers, mountain bikers, horseback riders, and other nature enthusiasts. Its historic, scenic and recreational qualities justify designating it as a visually sensitive resource.

District-wide visual resources: Frequented by recreational enthusiasts, the Pine Creek gorge, to the north and south of KY 80, is very scenic and contains many clifflines and dramatic rock outcrops. The wooded hillsides and ravines throughout the district add tremendous visual quality, and can be considered visually sensitive resources as well.

White Oak Creek District

Viewer Group Exposure and Sensitivity

Highway travelers moving through the White Oak Creek District are a sizeable viewer group. Though they are moving at speeds that do not allow good recognition of detail, travelers are perceptive of general landscape features and visual conditions. In the rugged, wooded western portion of the district, travelers will be cognizant of the corrugated landforms and the uniform forest cover. Through the eastern part of the district, they will experience views across rolling pastures with occasional houses and farm buildings. In the northeastern part of the district, travelers can be expected to perceive the large warehouse buildings, houses, roads, and overall higher level of development in this landscape. Travelers' overall visual sensitivity tends to be moderate to low and is partly affected by the landscape setting through which they are traveling. Individuals' sensitivity to visual impacts will be slightly higher in the wooded, hilly western part of the district than in the more developed areas to the east and northeast.

The White Oak Creek District's resident population is considerably larger than the populations of districts to the west. Most residents live in the eastern third of the district. Residents in the northeastern part of the district generally live in a visual environment that is increasingly impacted by residential, commercial, and warehouse development and they may have a lower level of visual sensitivity because of these conditions. Residents in the southeastern area view a predominantly pastoral landscape, and will generally have a moderately high degree of visual sensitivity.

Recreational enthusiasts pursuing activities that include hiking, mountain biking, camping, hunting, fishing, and bird watching frequent the western portion of the White Oak Creek District. The activities that this viewer group engages in are associated with relatively undisturbed natural settings, and they occur at a pace that allows a high degree of visual perception and attention to detail. Viewers' awareness of the attributes and the complexities of the woodland setting are influenced by previous experiences in similar settings. Recreational enthusiasts in this district will be highly sensitive to their environment and will readily notice elements and features that do not relate to the forest setting, and that are incongruous with their expectations.

Visually Sensitive Resources

- White Oak Creek
- Little White Oak Creek
- Wooded hillsides and ravines

Site-specific visual resources: No site-specific resources or particular areas stand out significantly as visually sensitive resources in the White Oak Creek District.

District-wide visual resources: Both White Oak Creek and Little White Oak Creek have high scenic quality and are accessible to recreational enthusiasts visiting the Daniel Boone National Forest. Both creeks and the steep, wooded slopes above them can be designated visually sensitive resources.

Sinking Creek District

Viewer Group Exposure and Sensitivity

Like other districts, highway travelers are a major viewer group within the Sinking Creek District. Due to high travel speeds and the tendency of the road to command their attention, their ability to perceive landscape features in much detail is usually less than that of residents and recreational enthusiasts. Travelers will, however, perceive the general shape and form of terrain features, the contrasts of open pastures and woods, and the occasional building. Landscape setting also influences travelers' sensitivity to visual impacts—in the western part of the district, they may be highly sensitive to visual alterations to the more open, pastoral landscape, or the steep, wooded ravines, while in the eastern part of the district, travelers may have lower sensitivity to visual impacts to a landscape that is occupied by increasing number of residences and other man-made elements.

Residents in the Sinking Creek District are mostly confined to the broad, rolling uplands. The density of homes is sporadic on the west side of the district, and generally increases toward the east. Because of their upland position, many residents in this district have expansive views across fields and pastures. They would be highly sensitive to large-scale alterations and new elements in the landscape that are visible, as far as a mile away. Should the new roadway require the crossing of one or more of the spectacular ravines, much care will need to be taken to minimize impacts to the existing visual and environmental quality.

Because the district is within the Daniel Boone National Forest, many areas are accessible to the public. Various recreational activities are associated with, and dependent upon, the forest setting. These include hiking, camping, hunting, fishing, and sightseeing. Due to the pace of their activities, these types of recreational enthusiasts are usually highly aware of their environment and are very sensitive to impacts within their visual range.

Visually Sensitive Resources

- Sinking Creek
- Clifty Branch
- Laurel Branch
- Wooded hillsides, rock outcrops and ravines

Site-specific visual resources: No site-specific resources or particular areas stand out significantly as visually sensitive resources in the Sinking Creek District.

District-wide visual resources: The creeks, like the creeks in the White Oak Creek District, the major creek corridors in the Sinking Creek District are very scenic and are accessible to residents and recreational enthusiasts traveling within the Daniel Boone National Forest.
Portions of Sinking Creek, Clifty Branch, and lower Laurel Branch, including the steep wooded slopes, rock outcrops and ravines along them, are visually sensitive resources. All of these scenic areas are worthy of preservation efforts or measures to mitigate any visual impacts.

Little Laurel River District

Viewer Group Exposure and Sensitivity

Highway travelers through the Little Laurel River District will perceive the open, rolling pastures, silhouetted tree lines, and the general shapes and outlines of buildings. Due to the existing landscape character, development patterns, overall visual quality, and high speeds, highway travelers will have moderately low sensitivity to visual impacts to the landscape in this district.

Little Laurel River District supports the greatest number of residents of any of the landscape districts along the I-66 corridor; residents, as a consequence, represent a dispersed but sizeable viewer group. Most homes are situated on higher ground along the broad tops or shoulders of the gently rolling hills. Many residents are afforded fairly distant views across the open landscape and could be significantly impacted by the construction of I-66 and the associated interchange with I-75, depending on their proximity.

Visually Sensitive Resources

No potential visually sensitive resources were identified in this district.

5.2.71 General Guidelines for Mitigating Visual Impacts

Creating a highway with good visual and aesthetic qualities requires a thorough understanding of the visual environment that the highway passes through, and the application of certain design techniques and methods. Many of the recognizably beautiful roads and highways in the United States are the result of the successful application of time-tested design techniques that improve both the visual character and the drivability of the road. Essentially, these techniques are founded on principles of good visual composition and on imperatives for roadway operation and safety.

As discussed in the earlier overview of viewer groups, the proposed highway will primarily be seen by four general categories of viewers: highway travelers, residents, workers, and recreational enthusiasts. These viewers will see the highway within multiple landscape settings and from multiple vantage points. Many of the guidelines presented below are focused on improving the visual fit and compatibility of the highway within the landscape setting, and on achieving a degree of visual harmony among the various highway components—horizontal alignment, cross-sectional grading, structures and other design elements.

Certain design guidelines and methods described below will be applicable to only a limited range of landscape conditions or settings while others will be suited to many situations. Also, several guidelines and methods can be used in combination where design goals are mutually compatible and consistent. To aid with implementation, each of the design guidelines is referenced to the landscape districts and alignment alternatives to which it might reasonably be applied.

It is intended for these guidelines to be used to strategically guide the decision making process throughout the planning and design of the proposed I-66 project. Initially, they may be considered in conjunction with other criteria to influence alignment selection, in the evaluation of the various alternatives. Once a preferred alignment or alignments are selected, the guidelines can be referenced to make further alignment refinements to achieve a better visual fit of the highway with the landscape, reducing potential impacts and improving visual quality. Where impacts are unavoidable, certain guidelines may be adopted as impact mitigation measures to lessen the severity of visual and physical impacts upon the landscape.
And finally, throughout the later design stages of the project, they can be incorporated to further refine the design in order to create a road that is both safer to drive and that is more visually harmonious with the landscape.

Overview of Design Guidelines

The design guidelines for this segment of the I-66 project are divided into four categories:

- Physiographic Fit (where and how the highway is positioned in the landscape) Guidelines
- Alignment, Profile and Cross-section Guidelines (roadway divide, curves, cuts and fills)
- Roadside Guidelines (primarily focused on planting and stormwater drainage issues) and
- Highway Structure Guidelines (designing bridges, walls, ramps, etc. to fit into the surrounding landscape)

Many of the guidelines overlap both thematically and categorically, even though they are only listed in one category. The general recommendations presented in the Visual Resource Assessment (May 2005) provide categorical information on improving visual quality. There are design guidelines that follow the general recommendations for each category above and application of design features to incorporate the above mentioned categories in the interstate's design can provide benefit to the visual environment.

For more detailed description of the general visual quality impact mitigation techniques or for additional background and methodologies on visual quality assessments, please refer to the Visual Resource Assessment study (May 2005).

5.3 Affected Social Environment

This section describes the environmental impacts of the No-Build and the Build Alternatives on the social environment in the I-66 Somerset to London Project Area. Direct, indirect and cumulative impacts are discussed.

5.3.1 Land Use Impacts

The project Build Alternatives would result in direct land use changes within the project area. The predominant change would be from agricultural to highway right of way. Limited land use change would include scattered residential and commercial land use to highway right of way.

Planning and zoning controls do not exist within the project corridor. These controls are limited to the City of London's corporate limits in Laurel County, and an area one mile beyond the corporate limits of Somerset in Pulaski County.

The project is located primarily within a rural, agricultural setting. Secondary and cumulative impacts will be limited primarily to the interchanges along the new facility; however as the cities of Somerset and London continue to increase in population, development may begin to occur between the cities and the interstate. Industrial firms typically prefer to locate within one to two miles of a major limited access roadway.[12] In addition, support businesses such as hotels, office supply stores, gas/convenience stores and restaurants could develop to meet the needs of commuters and goods transport related activities. These impacts are primarily dependent upon the efforts of local and regional efforts to recruit and develop industrial and commercial activities. It is not anticipated that such land use changes would occur immediately upon completion of the Interstate 66 project, but would be expected to evolve over several years.

As land use changes occur near the Interstate 66 project, it is likely that Pulaski and Laurel Counties will explore opportunities to implement county-wide planning and zoning to control development.

[12] Do New Highways Attract Business?
http://www.edrgroup.com/pages/pdf/Hodge-Weisbrod-NYNC.pdf

Farmland Socioeconomics

Direct farmland impacts have been previously discussed in section 5.2.58. Impacts to farmland may have social and economic impacts in addition to the direct conversion of farmland to transportation infrastructure as previously discussed.

The project is located in a rural area. Minor loss of land in active agricultural use is anticipated. The Project Team has coordinated with the United States Department of Agriculture, National Resources Conservation Service. Land Evaluation Site Assessment criteria were used to complete the Farmland Conversion Impact Rating. The Farmland Protection Act requires identification of proposed actions that could affect land classified as prime and unique farmland.

Pulaski County will require between 819 and 979 acres of land to be converted to highway right of way. The total acreage of prime farmland required would be between 54 and 163 acres. The percentage of farmland to be converted would range between 0.5 and 0.6%.

Laurel County will require between 1,094 and 1,113 acres to be converted to highway right of way. The total acreage of prime farmland required would be between 87 and 104 acres. The percentage of farmland to be converted would range between 0.14 and 0.17%.

The Farmland Protection Act requires that the LESA/FCIR assessment consider a feasible alternative to avoid farmland impacts if the score of the evaluation exceeds 160 of a total 260 points. The scores in Pulaski County ranged between 105.6 and 121.2. The scores in Laurel County ranged between 150 and 154. No adverse impacts upon farm operations or agricultural activities along the project corridor are anticipated. Therefore an avoidance alternative is not required.

Impacts will be realized by farms that will lose property being converted to highway right of way. Some farms may be divided by the interstate, and right of way officials will work with the affected owners to ensure safe passage is provided to minimize disruption to farming activities. Farming services will not be directly affected by the project. Most of these services are located in Somerset and London.

Cumulative and indirect impacts to area farmland will be dependent upon local and regional development efforts. Highway commercial development is anticipated adjacent to some of the project's proposed interchanges. Local officials and leaders are attempting to bring industrial and commercial firms to Pulaski County and Laurel County. These firms prefer to be located in proximity to major highways. If such development occurs in Pulaski and Laurel County, farmland adjacent to Interstate 66 would be impacted by future development plans and further loss is anticipated.

Positive secondary and cumulative impacts could be realized as farmers make use of the interstate to deliver products to regional market bases. Additional benefits would be safer, more efficient travel to the agricultural farm services in the county seats for farmers.

5.3.2 Community Services Impacts

Schools

No educational buildings are located within the right of way limits of any of the Build Alternatives. Partial acquisition of the Shopville Elementary School parking lot will be required and is addressed in Section 5.3.6, *Impacts to Nonprofit Organizations*. No direct effects are anticipated upon public or private school buildings located within the project corridor. All Build Alternatives are anticipated to have positive direct and cumulative impacts upon safety for school buses, and for the administrators, teachers and students who travel to and from area schools in private vehicles. Truck, service and commuter traffic would be diverted from area roadways, including KY 80, making area roadways safer for the school related traffic. Some secondary roadways connecting to Interstate 66 via interchanges may experience some increases in traffic volumes at the proposed intersections. These increases could potentially affect Levels of Service and safety.

Emergency Vehicles

The proposed project would not have a direct impact on police and emergency response vehicles since none of these facilities are located within highway right of way limits. Reduced response times are not anticipated to be measurable in relation to existing roadway conditions.

Hospitals

No services associated with hospitals in the region will be impacted or impaired by any of the Build Alternatives. No plans in the near future are associated with construction of hospital facilities within the right of way or areas near the project corridor.

Utilities

No long-term impacts are anticipated for utilities in the project area. Utility relocations required by the project upon selection of a Build Alternative will be coordinated with local service providers. Any anticipated disruptions to service (i.e., power outages, loss of communication signals) would be short term.

Rail Transit

The CSX railroad is located east of London in Laurel County. No impacts are anticipated for rail transit from the construction of Interstate 66 project.

Socioeconomic Impacts

5.3.3 Relocations

The project will require relocations, and the total numbers for residential and business relocations will depend upon which Build Alternative is chosen. Relocations are divided and compared within the two project counties in Table 5.3.3-1.

Residential Relocations

Each Build Alternative would require residential relocations. The relocations are distributed along the entire project corridor, and not concentrated in one particular area. The acquisition and relocation program for the Interstate 66 project shall be conducted in accordance with the Uniform Relocation Assistance Program, Title VI of the Civil Rights Act of 1966, and Executive Order 12898 – Environmental Justice. Table 5.3.3-1 summarizes and compares Residential Relocations: Every consideration has been given in the planning and development of this project to consider environmental impacts that could disproportionately or adversely affect minority or low-income groups. Reviews of census tracts (see Chapter 4) that coincide with the project corridor indicate that the area does not feature disproportionate percentages of minority or low-income groups. Additionally, conversations were held with local elected officials to

determine if any minority or low-income groups were located within the project corridor. Local officials concurred that no disproportionate percentages of these groups exist within the corridor. Windshield surveys of the area did not reveal any neighborhoods of ethnic communities.

Table 5.3.3-1 – Residential Relocations by Build Alternate

Alternate	Pulaski County	Laurel County	Gross Total	Total Residents to be Relocated
B	10s/6m	-	16	30 to 65
D	6s/8m	-	14	25 to 65
B-D	9s/5m	-	14	25 to 65
K	10s/9m	-	19	35 to 70
KY 80 Shifted	22s/22m	-	44	85 to 165
KY 80 Modified	11s/12m	-	23	45 to 85
G	-	56s/51m	107	215 to 420
H	-	39s/39m	78	165 to 340
I	-	24s/14m	38	75 to 145
L	-	27s/34m	61	115 to 220
M	-	16s/42m	58	115 to 215

s = single family units, m = mobile homes

Build Alternatives D and B-D have the fewest number of relocations, 14, in Pulaski County. The highest number of relocations required would be within the right of way limits for KY 80 Shifted, 44. Build Alternatives D and B-D require the least amount of residents, 25 to 65, to relocate, while KY 80 Shifted would require the most, 85 to 165. Table 5.3.3-1, above, compares estimated ranges of relocated residents by each Build Alternative.

Build Alternative I in Laurel County has the fewest number of relocations (38). Build Alternative G has the highest total, 107. Build Alternative I has the fewest total range, 75 to 145, of residents required to relocated, while Build Alternative G would require the highest range (215 to 420).

The characteristics of the residents who may be required to relocate include couples, families with children, and single inhabitants. Ages vary from infancy to elderly. Some low income and elderly residences will be required to relocate.

Disproportionate impacts to these sensitive groups, and to minority and ethnic neighborhoods are not anticipated. Field trips and conversations with local officials have indicated that physically impaired residents or homes with five or more family members were not apparent. In addition the Project Team consulted with local officials, including a Pulaski County Magistrate and the County Judge Executive of Laurel County's office to determine if family or socially interdependent clusters would be required to relocate. It appears that none of these situations exist within the project right of way limits for any of the Build Alternatives.

If any special needs residents are identified during the Right of Way phase of this project, state right of way officials will work with local officials, including health departments, the Social Security Office and others to determine the special needs of these groups. Every effort will be made to assure that the special needs are met to minimize impacts of relocation effects. For example;

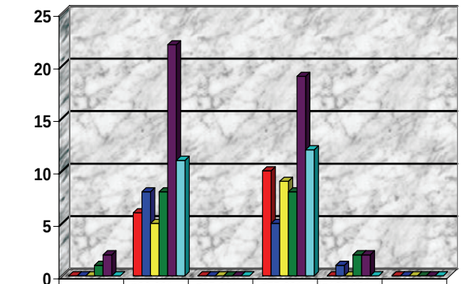
- If a family or social cluster is identified, officials will work with the affected group to find a suitable replacement parcel to ensure the group remains intact;
- If physically impaired residents are identified, barrier free entrances will be constructed to adapt replacement housing for these special needs residents.

The Socioeconomic Baseline Analysis and Conceptual Stage Relocation Report indicated that no measurable impacts exist for selecting suitable replacement housing for area residents. No other KYTC projects, county or regional projects that would have competing relocation needs are scheduled for construction at the time of this project. The project will be constructed in segments, which will minimize the competition for suitable replacement housing in both Pulaski County and Laurel County. Reviews of the U.S. Census Bureau data, conversations with local officials and reviews of real estate information indicate that the housing markets in each county have been steady for the past five years. This includes rental units as well as owner-occupied units. Mobile home owners and tenants will be able in several cases to relocate to the remaining parcel of land.

Last Resort Housing (LRH) would be used if comparable housing is not available and suitable replacement housing exceeds a value of $22,500 above the impacted home's appraised value. LRH would also be used to cover additional costs to ensure a replacement home meets the Decent, Safe and Sanitary conditions as defined in the KYTC Division of Right of Way Relocation Assistance manual. At this time, no residential replacements appear to require LRH funding.

The Following are charts comparing the affected residential properties by value for Laurel County and Pulaski County, and a chart comparing the available replacement housing for each county:

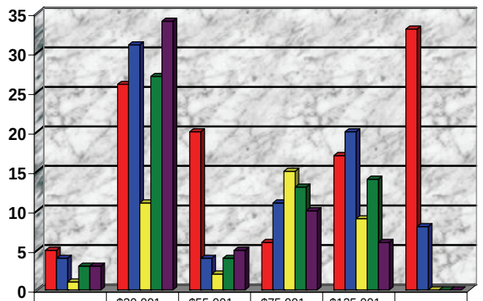
Affected Residential Properties by Value, Pulaski County



	< $30,000	$30,001 - 55,000	$55,001 - 75,000	$75,001 - $125,000	$125,001 - 200,000	>$200,001
Alt. B	0	6	0	10	0	0
Alt. D	0	8	0	5	1	0
Alt. B-D	0	5	0	9	0	0
Alt. K	1	8	0	8	2	0
Alt. KY 80 Shifted	2	22	0	19	2	0
Alt. KY 80 Modified	0	11	0	12	0	0

Most of the homes that would be acquired in Pulaski County for each alternative are valued between $30,001 and $55,000 and $75,001 and $125,000. Alternative B-D also includes no homes in excess of $200,000.

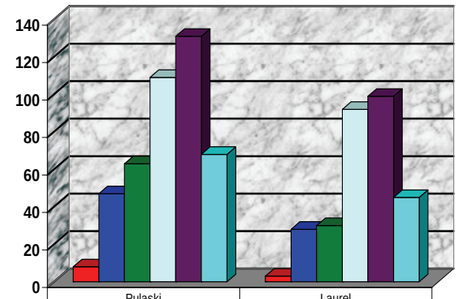
Affected Residential Properties by Value, Laurel County



	< $30,000	$30,001 - 55,000	$55,001 - 75,000	$75,001 - $125,000	$125,001 - 200,000	>$200,001
Alt. G	5	26	20	6	17	33
Alt. H	4	31	4	11	20	8
Alt. I	1	11	2	15	9	0
Alt. L	3	27	4	13	14	0
Alt. M	3	34	5	10	6	0

Most of the homes in Laurel County are in the $30,001 to $55,000 range. Alternative G has the highest comparative number of homes less than $30,000 in value, highest in the $55,001 to $75,000 range and the most homes valued in excess of $200,000.

Available Housing, Laurel and Pulaski Counties



	Pulaski	Laurel
< $30,000	8	3
$30,001 - 55,000	47	28
$55,001 - 75,000	63	30
$75,001 - $125,000	109	92
$125,001 - 200,000	131	99
>$200,001	68	45

Both counties feature the greatest number of homes in the $75,001 to $200,000 range. When comparing the totals of homes to be acquired to the number of homes available within the respective counties, the only area of available housing that does not meet the demand for housing to be acquired would be the number of available homes valued below $30,000 in Laurel County. KYTC right of way is allowed to find suitable replacement housing that falls between the affected home's appraised value and the value plus $22,500. Reviews of the totals of homes in the $30,001 to $55,000 range for Laurel County indicate that the 5 homes of Alternative G would be able to find adequate replacement housing meeting Decent, Safe and Sanitary standards within the $22,500 limit, and Last Resort Housing funds would not likely be required.

All relocation activities on this project will be performed in accordance with 49 CFR Part 24, Uniform Relocation and Real Property Acquisition Act of 1970 as Amended. The appropriation of property will also follow any other federal, state or local regulatory requirements.

5.3.4 Environmental Justice

In accordance with the Federal-Aid Highway Act of 1970 and Executive Order 12898 on *Environmental Justice*, every consideration has been given in the planning and development of this project to consider environmental impacts which might disproportionately or adversely impact minority or low income groups. The selected alternate will have no adverse effects on minority or low-income populations, and no neighborhoods or communities will be adversely impacted. The project is not expected to have any disproportionate or adverse impacts to low income groups or neighborhoods. No environmental justice issues have been identified in association with this project.

Secondary and cumulative impacts to minority and low income residents of the project counties appear to be primarily positive. Improved social interaction is anticipated for each county and for the region. In addition, as local regional officials make efforts to recruit industrial and commercial businesses into the area, additional jobs will be created. Many of these jobs could be filled by low-income and minority residents.

5.3.5 Business Relocations

The community of Shopville, in Pulaski County, would lose most of its businesses if KY 80 Shifted (5 businesses) or KY 80 Modified (4) was selected as the Build Alternative. The businesses are mainly retail/service oriented and provide convenience for Shopville residents. One small manufacturing company exists. Each of the businesses is estimated to have 2 to 6 employees. If KY 80 Shifted is selected as the Build Alternative, 10 to 30 employees may be affected, and if KY 80 Modified is chosen, 8 to 24 employees could be impacted. The availability of suitable replacement property is very limited to non-existent. The business owners may elect to relocate to a more densely populated area of Pulaski County such as Somerset, but the community would lose the services of these businesses. The affected employees may choose to relocate with the businesses or seek employment opportunities elsewhere. It is possible that some may become unemployed. Therefore secondary and cumulative impacts would be associated with these relocations for the community of Shopville including a weakening of community cohesion. Relocation efforts between KYTC right of way agents and local officials is required to assist these businesses in finding suitable replacement properties as close to Shopville as possible.

Alternative H, in Laurel County, would require relocation of three structures on the Chestnut Knolls Air Park property. The grass runway would not be affected, but the structures may be either relocated or reconstructed on suitable areas of the remaining parcel or on a suitable replacement parcel adjoining the existing property. No employees will be affected and the Air Park would not be required to close.

Alternative B, in Pulaski County, would require relocation of one cell tower. A suitable site on a parcel nearby will be sufficient. No employees will be affected.
Although a small number of businesses would be required to be relocated, the overall cumulative and secondary impacts to this project appear to be positive from a commercial/industrial viewpoint. New highways can be influential in attracting companies to establish in a project area. As mentioned in the land use section earlier, these companies prefer to locate within one to two miles of a limited access highway. If local and regional efforts are initiated and continued, in time, the area would benefit from the creation of new jobs, increased tax revenues associated with income taxes, sales taxes and increased property values.

5.3.6 Impacts to Nonprofit Organizations

No nonprofit organizations are located within the right of way limits of any of the 11 Build Alternatives. The Shopville Elementary School parking lot will be partially acquired if KY 80 Shifted is selected as the Build Alternative. This parking lot also functions as a school bus depot and fueling station. KYTC right of way officials will work with the school to identify potential land adjacent to the school property that may serve as replacement space for the loss of this area. If not space is available, the school will experience crowding in the remaining parking area. No other long term or short term negative impacts have been determined for nonprofit resources.

Cumulative and secondary impacts are not anticipated for most area nonprofit organizations. If the Shopville Elementary School parking lot partial acquisition cannot be mitigated through purchase of additional land, the cumulative and secondary impacts may include the removal of the bus depot and fueling station to a site off existing school property.

5.3.7 Neighborhood/Community Cohesion Impacts

The Project Team has made every effort to attempt avoidance of direct impacts to neighborhoods and communities. The proximity of the two of the project area alternatives to KY 80 provided some difficulty in these efforts. The communities of Shopville and Stab, both in Pulaski County, are situated along KY 80. KY 80 Modified and KY 80 Shifted would have direct impacts upon Shopville.

Shopville includes several small businesses, and elementary school, several residences and a city park. Residential land use in located mainly to the south of KY 80. The businesses and the school are located north of KY 80. A four-lane, limited access facility as proposed with KY 80 Modified or KY 80 Shifted could have divisive, disruptive effects to Shopville as a result of dividing the residential community from the business community. Access between the residential and non-residential areas would remain open via KY 461. KY 80 Shifted would require relocation of five businesses, partial acquisition of the elementary school's parking lot, acquisition of land upon which two cemeteries are located, and total acquisition of the Shopville City Park. The Shopville City Park was funded in part by Land and Water Conservation Funds and would require Section 4(f) evaluation and Section 6(f) involvement (See Chapter 6 for more detail on 4(f) and 6(f) evaluations). KY 80 Modified would require acquisition of four businesses, and one cemetery. Shopville currently is provided access to the north via Dahl Road. If either KY 80 Modified or KY 80 Shifted is selected as the Build Alternative, this access will remain open for Shopville.

Stab is located south of the project and along a portion of State Highway 1675, also known as Stab Road. No businesses, nonprofit organizations or other community resources appear to require relocation by any of the project alternates in Stab. Alternate K is located just north of Stab. Residents of Stab will remain able to access areas north of the proposed Alternate K via State Highway 1675 and Rocky Tree Road. No divisive or disruptive impacts are associated with this project.

5.4 Impacts to Cultural Resources

5.4.1 Cultural Resource Impacts Introduction

Section 106 of the National Historic Preservation Act of 1966 (NHPA) requires federal agencies to take into account the effects of their undertakings on historic properties (those that are on, or eligible for inclusion on, the National Register of Historic Places (NRHP) and afford the Advisory Council on Historic Preservation (ACHP) a reasonable opportunity to comment. The historic preservation review process mandated by Section 106 is outlined in regulations issued by the ACHP[13], with project specific efforts discussed in sections 4.4 and 8.2 of this document.

Potential direct, indirect and cumulative effects of the project are discussed in this document. The Indirect and Cumulative Effects Analysis (ICEA) for all resources is covered in Chapter 7 of the DEIS. The potential direct effects on historic properties and archaeological resources are presented here.

5.4.2 Types of Impacts to Historic Resources

Short-term impacts associated with project construction could affect cultural resources in the project area. Physical crossing of these resources may necessitate the removal or excavation of historic structures. Project related noise, vibration and visual impacts could also affect historic properties. Such properties could also be affected by partial land takings that may affect their integrity.

Adverse impacts associated with project construction could affect cultural resources with the project area. These adverse effects may include reasonably foreseeable effects caused by the undertaking that may occur later in time, be farther removed in distance or be cumulative. Adverse effects on historic properties may include, but are not limited to:

- Physical destruction of, or damage to all or part of the property
- Alteration of a property, including restoration, rehabilitation, repair, maintenance, stabilization, hazardous materials remediation, and provision of handicapped access, that is not consistent with the Secretary's standards for treatment of historic properties and applicable guidelines
- Removal of the property from historic location
- Change of the character of the property's use or of physical features within the property's setting that contribute to its historic significance
- Introduction of visual, atmospheric or audible elements that diminish the integrity of the property's significant historic features

The assessment of effects identifies each historic property within the Area of Potential Effect (APE) and the anticipated effect of the respective alignments on that resource.

The cultural resource identification, assessment of effects and proposed mitigation for adverse effects is a part of the Section 106 process, with opportunities for the consulting parties[14] to comment on the study findings, determinations and recommendations (see section 8.2 for more information on public involvement in the cultural resource evaluations).

5.4.3 Historic Properties and Project Related Effects

In order to identify historic resources within the project APE and determine their eligibility for listing on the National Register of Historic Places, field research for architectural resources was conducted from April – July, 2002, and throughout October, 2003, by the firm of Wilbur Smith and Associates. Further research was conducted in various archives and libraries to develop a historic context in which to evaluate the significance of these resources. National Register evaluations of each site were then developed in accordance with Criteria A, B, and C, and boundaries were determined for all sites recommended eligible.

Determinations of eligibility for architectural resources to meet National Register criteria were reviewed by the KYTC and FHWA, and approved by the SHPO on February 4, 2003, and March 22, 2004. These determinations were then provided for review at the October 12, 2004, consulting parties meeting in Somerset. As a follow-up to that meeting, all individuals and organizations approved as consulting parties by the FHWA in consultation with the SHPO, received a CD containing documentation and mapping of all historic resources identified within the project APE. This information was also provided at public meetings held on November 29 and 30, 2004. On January 20, 2005, the Kentucky Transportation Cabinet (KYTC) notified all consulting parties that their comments relating to the 106 process were under review and formal responses to those comments would be sent to each consulting party prior to the next consulting parties meeting. Responses to those comments are included in Appendix B.

The determinations of eligibility are based on reviews by KYTC, FHWA, the SHPO, and comments received from the consulting parties. Based on these reviews, draft determinations of effect for all listed and eligible historic resources within the project APE were developed and presented here.

Project Field Investigations and Findings

While the original Area of Potential Effect (APE) for the Phase IA report encompassed most of the 1000 foot wide bands representing proposed alternates, two bands are located outside the Phase IA study area. These new bands were used to develop a Phase IB APE. The purpose of surveying these new bands was to identify historic resources (defined as fifty years or older), determine their eligibility for listing on the National Register of Historic Places, and assess the project's effect on eligible properties.

Field and archival research throughout October 2003 led to the evaluation of one-hundred and fifty-four (154) sites for eligibility to the National Register of Historic Places. Of these 154 sites, 29 have been determined as on or eligible for the NRHP.

There are six alternates encompassed in the APEs of both Phase IB and Phase IA. Determinations of effect were not made for Phase IA sites in the original report as the alternates had not been decided upon; therefore, determinations are shown in this report. Of the twenty-nine (29) eligible, listed, or recommended eligible sites from Phase IA and Phase IB, seven are adversely affected in some form by one or more of the alternates: PU 59, PU 62, PU 337, PU 377, LL 69, LL 182, and LL 183.

Current proposed alignments for Alternates 80 Mod, 80 Shift, and K would have an adverse effect to site PU 59. The right-of-way lines for these alternates intersect the National Register boundary for this site thus allowing for adverse effects to occur to this bridge, unless the current alignments and right-of-way lines are revised away from the bridge. Mitigation measures decided in an MOA may include State Level 1 documentation and/or relocation of the bridge. Proposed Alternates B, D, B-D, I, L, H, G, and M have No Effect to site PU 59.

The proposed alternative KY 80 Modified may have an adverse noise effect on site PU 62. Should KY80 Modified be selected as the preferred alternative, refined noise analyses will be conducted to assess the feasibility and reasonableness of barrier abatement of any adverse noise effect. Should a barrier not be feasible/reasonable at this location, alternative noise abatement measures will be investigated. Noise mitigation commitment will be a part of the Memorandum of Agreement for this project. Alternates 80 Shift, B, D, B-D, K, I, L, H, G, and M have No Effect to site PU 62.

The current proposed alignment for Alternate 80 Shift would have adverse visual effects to PU 337. Mitigation measures would need to be included in an MOA and may include a landscape plan to minimize visual effects. Proposed Alternates 80 Mod, B, D, B-D, K, I, L, H, G, and M have No Effect to site PU 337.

The current proposed alignment of Alternate B would cause adverse visual effects to site PU 377 and access to the site would be cut off. The visual effects could be minimized by a landscape plan decided in an MOA. Proposed Alternates 80 Mod, 80 Shift, D, B-D, K, I, L, H, G, and M have No Effect to site PU 377.

The current proposed alignment of Alternate I would have an adverse effect on site LL 69. The current alignment would require demolition of the site. Mitigation measures could include relocation of the schoolhouse to a compatible sight of similar setting and/or State Level 1 documentation. Proposed Alternates 80 Mod, 80 Shift, B, D, B-D, K, H, L, G, and M have No Effect to site LL 69.

The current proposed alignment of Alternates L and H would adversely affect site LL 182 due to the proximity of the right-of-way for the exit ramp. This proximity

[13] http://www.achp.gov/

[14] Parties with an expressed interest in Historic Preservation apply for consulting party status for the Section 106 process.

would lead to demolition of the house. Mitigation measures such as State Level 1 documentation would need to take place. If the alignment is revised away from the house, then there could be a negative visual effect to the site overall and mitigation measures would need to be decided in a Memorandum of Agreement (MOA). Proposed Alternates 80 Mod, 80 Shift, B, D, B-D, K, I, G, and M have No Effect to site LL 182.

Current proposed alignment for Alternates L and H also would have an adverse visual effect to site LL 183. Mitigation measures would need to be included in an MOA and may include a landscape plan to minimize visual effects. Proposed Alternates 80 Mod, 80 Shift, B, D, B-D, K, I, G, and M have No Effect to site LL 183.

The proposed alternates will have No Effect to the following listed, eligible, or recommended eligible sites: LL 11, LL 98, LL 232, PU 60, PU 62, PU 65, PU 195, PU 207, PU 213, PU 221, PU 222, PU 224, PU 274, PU 297, PU 301, PU 375, PU 441, PU 445, PU 452, PU 458, RK 43, RK 44.

A Memorandum of Agreement (MOA) will be required for any eligible or listed sites that will be adversely impacted by the project. Mitigation of adverse impacts in the MOA may include but are not limited to State Level 1 documentation, landscape plans, relocation of a structure, or other measures decided upon by the Federal Highway Administration, the Kentucky Transportation Cabinet, and the Kentucky Heritage Council.

If an alignment for any Build Alternative is shifted to avoid demolition of a historic site, visual and/or noise impacts would most likely still be associated with these sites, and as a result, mitigation measures will still be required.

Following are summations of the seven sites and the Build Alternatives that would affect them. The 21 sites that were identified, but will not be impacted are summarized in the section immediately following the sites with effects. An exhibit mapping the location of these 29 sites has been included in Appendix C (Figure 5.4.3 exhibited in the same order as presented here, with site number label on each figure).

Historic Sites with Adverse Effects

Site PU59, Buck Creek Bridge, was constructed in 1932. It is a triple truss type bridge located on Old KY 80 at Stab. The bridge is eligible for the NRHP under Criterion under Criterion C for construction method. The Buck Creek Bridge is a Pratt truss bridge, once common in Kentucky. Approximately half of the Pratt truss bridges in the state remain, and Buck Creek Bridge is one of two remaining in Pulaski County. The recommended boundary surrounds the bridge and a slight approach area at both ends. The site is located within the proposed rights of way for Alternatives K and KY 80 Modified.

If Alternatives K, KY 80 Modified, or KY 80 Shifted were selected as the Build Alternative, Buck Creek Bridge would be adversely affected. If Alternative K or Alternative KY 80 Modified is selected options to avoid use of any land within the rights of way will be examined. Visual impacts would occur if any of the three alternatives identified were to be selected.

Site PU62, the James-Hansford House, was listed on the NRHP in 1985. It is located in view of Existing KY 80 in the Shopville area. Construction of any of the build alternatives would not result in adverse visual impacts, but if KY 80 Modified is selected as the Build Alternative, impacts associated with noise levels are anticipated. Noise levels associated with KY 80 Modified are predicted to increase by more than 10 dBA over existing sound in this area, which would result in adverse noise effects to this site.

Site PU337, the Daryl Whitaker House, was constructed circa 1880, and is a one-story side-gabled frame home with a partial width shed porch that is centered on the façade. The porch is supported by wooden posts. A large stone chimney is situated on the right gabled end, and a newer block chimney was added to the left side of the house. Two outbuildings are associated with this site, a smokehouse cellar (PU337a), and a rear sloping, shed-roofed shed (PU337b). The property is recommended as eligible for the NRHP under Criterion C as an intact example of a late 19th Century residence. The boundary for Site PU337 totals 13.5 acres, and surrounds the main building, the two outbuildings and the yard.

The KY 80 Shifted Alternative would cause adverse visual effects to this site. No other effects are anticipated.

Site PU377, the Leo Gilliland House, was constructed in 1880, and is a two-story, side-gabled I-House. A single centrally located chimney is present. Two outbuildings, a barn and an outbuilding, are associated with this property. The Gilliland House is recommended as eligible for listing on the NRHP as an excellent example of 19th Century Greek Revival architecture, a style that is not common in Pulaski County. This recommendation falls under Criterion C. The boundary for Site PU377, which surrounds the main building and yard, is 24.6 acres.

Build Alternative B would have adverse visual effects and an adverse noise impact on this site. Alternatives B-D and KY 80 Modified would also have adverse noise impacts on this site.

Site LL69, the Maple Grove School, was constructed in 1903, was in operation from 1903 until 1964. This structure was the third school on the site. It is a one-story front gabled, frame building. Four outbuildings on the site are associated with the school building. Site LL69a is a pair of modern outhouses built in 1980. Suite LL69b is the original two-seat girls' outhouse. Site LL69c is a picnic shelter that was also constructed in 1980. The property is recommended as eligible for the NRHP under Criterion A for its association with the development of education in rural Kentucky.

The Maple Grove School would experience adverse effects if Alternative I is selected. The construction of Alternative I would result direct and visual impacts associated with taking the school for project right of way requirements. If the alignment is shifted to avoid loss of the school structure, construction of Alternative I would also result in noise levels increasing by over 10 dBA for this site. No other impacts or alternatives would be associated with this site.

Site LL182, the Johnson House, was constructed circa 1911, and is a one-story Craftsman stone house resting on a stone foundation. The site includes two outbuildings, a front gable barn (LL182a) and a shed (LL182b). The property is recommended for the NRHP under Criterion C as an example of exceptional workmanship through its stone construction method. The suggested boundary for Site LL182 includes the house, its front yard and the driveway. The outbuildings or land were not included because they do not lend to the feel of the era of significance nor do they contribute to an agricultural complex landscape.

The Johnson House would experience adverse visual effects from Build Alternatives H or L. A direct impact would occur if Build Alternative H or L is selected. Preliminary design proposes ramp connecting the KY 192 interchange with I-66. This site would be located within the right of way requirements for the interchange. Options to avoid use of land within the LL182 boundary is recommended to avoid use of land and minimize or avoid visual effects associated with the construction of the project. No other alternatives or impacts would be associated with this site.

Site LL183, the Wyan House, was constructed in the 1940s, and is a one-story, brick house with three bays. It sets on a cut stone foundation, and features a full width porch with an extended roof supported by square, brick columns. The site features four outbuildings, a shed (LL183a), a brick well house (LL183b), a gambrel roof garage constructed in 1952 (LL183c), and a tobacco barn (LL183d). The property is recommended as eligible for the NRHP under Criterion C as an exceptional example of a brick house of the Arts and Crafts movement. The use of brick on a Craftsman style house is unusual for the area.

Site LL183 would be adversely affected if Alternatives H or L were selected. The effects would be associated with visual impacts. No other effects are evident from these or other Build Alternatives.

Sites with No Cultural Historic Adverse Effects

The sites below were part of the initial Cultural Historic baseline analysis. At this time, no direct or indirect impacts are anticipated for these sites. If alignments are shifted and these sites cannot be avoided, Section 106 and the 4(f) evaluation processes must be initiated for these sites.

Site PU65, the James Family Cabin is a rare example of a square notch log cabin and was built circa 1880. The property is eligible for listing in the NRHP under Criterion C because it displays architectural construction techniques that are uncommon in Pulaski County.

Site PU 60, the Avis Harper House, is a three-bay I-house built circa 1830. It sets upon a limestone foundation. The Harper House was listed on the NRHP in 1985.

Site PU 71, the Sowder Cabin, This is a two-story I-house with Greek Revival detailing that rests on a stone foundation and is clad in aluminum siding. It is three bay with six over six windows. The entry door has sidelights and transom. There is a two-story entry porch with gabled roof decorated with dentils that are repeated in the frieze. The lower porch supports are replacements. Two exterior stone chimneys are at both ends of the house and there is a shed addition to the rear. The side gable roof has asphalt shingles. This property is recommended as eligible for the NRHP.

Site PU 195, the Abandoned House on Soules Chapel Road, is a one and one half story house set on a stone foundation. The original section of the home, constructed circa 1856, is comprised of V-notched logs. The site includes three outbuildings that are associated with the property. The site is recommended as eligible for listing in the NRHP under Criterion C for its proximity to Somerset which shows early settlement patterns. It is also an example of a settler's log cabin that was modified to the style of the period when the family became established.

Site PU 207, the Flat Lick Creek Bridge on Barnesburg Road, is a three-span, concrete slab bridge over Flat Creek on Barnesburg Road. The bridge rests upon two concrete piers that span its width. Decorative railing with rounded edges and a series of cutouts resembling vertical spires are featured. The bridge was constructed in 1946 and is a type that was commonly used between 1920 and 1960. The site is recommended as eligible for listing in the NRHP under Criterion C because the bridge was constructed at the start of the post-war period when funds were allocated to rural highways and the "Good Roads Amendment" was passed. The railing employs the Streamline Deco styling.

Site PU 213, the Jeff Harper House, includes a one and one half story Craftsman style frame house setting on a concrete block foundation. The farm house was constructed in 1946 and a total of nine outbuildings are associated with this site, which is recommended as eligible for listing in the NRHP under Criterion C for its demonstration of an agricultural complex, which was prevalent for larger farms of the area. It incorporates outbuildings that were integral to tobacco production, chicken farming and dairying. Many tobacco farms were forced to diversify when World War II ended, and farms in this area initially raised chickens and later dairy operations were brought in to the agricultural operations.

Site PU 221, PU 222, the Whitaker Cemetery and Home Place. Site PU221 is a small cemetery located on Whitaker Cemetery Road. There are approximately eighteen historic graves and fifteen modern in the cemetery. The property is recommended as eligible for listing in the NRHP in conjunction with PU 222. This site is eligible under Criterion B as the family cemetery for site PU 222. Family cemeteries were typically located near the home site but in a special place such as a hilltop. In this case, the cemetery is located out of reach of the river but within sight of the house.

Site PU222 is a two-story, cross gabled, frame residence resting on rock piers and built circa 1890. It is clad in weatherboard siding and is topped by a standing seam metal roof. Four outbuildings are associated with this property. The property is recommended as eligible for listing in the National Register of Historic Places with PU 221 under Criterion B for its association with a second generation of a family who were prominent in the Line Creek area; and under Criterion C for its characteristics of the area, time, and income level of the family.

Site PU 224, the Cooper School, is a front gabled, one room school house built in 1936. The property is recommended as eligible for listing in the NRHP under Criterion A for its association with the development of education in rural Kentucky.

Site PU 274, Burdine School, No. 1, was constructed circa 1910. It is a one-story, side gabled one room schoolhouse. It is eligible for listing in the NRHP under Criterion A for its association with the development of education in rural Kentucky.

Site PU 297, Abandoned House, is a one and a half story, side-gabled, residence on a cut stone foundation with a full width, inset front porch with extended roof. Three barns are associated with the property (Sites PU297a, b and c). The property is recommended as eligible for listing in the National Register of Historic Places under Criterion C as an excellent example of a Craftsman home with tapered columns on a full-width porch, original Arts and Crafts door and windows, and gabled roof. The property also displays characteristics of an agricultural complex, specifically a tobacco farm, through its numerous outbuildings. A side addition to PU 297a suggests a residence for a field hand.

Site PU 301, the Short Creek School, was constructed circa 1910. It is a one-story, front gabled frame structure. The property is recommended as eligible for listing in the NRHP under Criterion A for its association with the development of education in rural Kentucky.

Site PU 375, the Sinking Valley School House, was constructed circa 1896. It is a one-story front gabled, frame structure now used as a residence. The site is recommended as eligible for the NRHP under Criterion A for its association with the development of education in rural Kentucky.

Site PU 441, the Phelps House on Pine Hill Road, is a one-story frame that sets upon a cute stone foundation. It features five bays – two are doors and four are windows (two over two). The home is estimated to have been built in or near 1904. The site has ten associated outbuildings, and is recommended as eligible for listing in the NRHP under Criterion C for demonstrating an agricultural complex prevalent for a larger farm of the area. The multitude of outbuildings reflects the variety of livestock kept and crops grown.

Site PU 445, the Sewell House, This is a one-story, frame house resting on cut stone and covered by vinyl siding. It has three bays and the windows are two over two. The partial-width porch has a shed roof and turned post supports with spindlework detailing which give it a Folk Victorian look. The cross gable roof has standing seam metal and a brick chimney and a concrete block chimney on the exterior west elevation. The ells formed by the rear cross gable have been infilled with shed additions that rest on concrete block. The east elevation addition is an enclosed porch. The west elevation addition wraps around the rear to form a partial porch. This property is recommended as eligible for the NRHP.

Site PU 452, the Simpson House, This is a one story, frame house on a concrete foundation with vinyl siding. It has three bays and three over one windows. The partial-width porch has a hipped roof and decorative metal supports. The hip on gable roof has asphalt shingles and there is a brick chimney on the south elevation. The hipped addition to the rear has been enclosed. This property is recommended as eligible for the NRHP.

Site PU 458, the Edwards House, This is a one and a half story, frame house on a stone foundation and covered in vinyl siding. It has three bays and the windows are two over two. The full-width porch has an extended roof and decorative metal supports. The side gable roof has standing seam metal. There is a brick chimney on the east exterior that has been covered in concrete and a brick chimney on the interior southern slope. There is a rear shed extension of later construction. This property is recommended as eligible for the NRHP.

Site LL11, the First Evangelical Reform Church, is currently listed on the NRHP. The church is also known as the Swiss Colony Church. It is a one-room framed building basically the same in all respects as when it was constructed in 1884. This site is outside the project's APE and not formally a part of this study.

Site LL98, the Sunny Brook School, was built circa 1930, and is a one-story, front gabled, frame structure. The property is recommended as eligible in the NRHP for its association with the Education Theme under Criterion A.

Site LL232, the Old Cold Hill School, also known as the "Old Coal Hill School," is a one-story, cut stone schoolhouse that is currently used as a garage. The building was constructed circa 1935. The site is recommended as eligible for listing in the NRHP under Criterion A for its association with WPA building programs in America. WPA did not often construct schoolhouses of only one room in rural Kentucky. They preferred instead to construct multi-room schools in centrally located towns to assist efforts in consolidating school districts. In addition, the site is eligible for listing under Criterion C for its notable example of construction of a one-room WPA school house using native stone.

Site RK 43, the Ruby Adams House, was built in the early 1930s. It is a two-story, hip on gable, stone residence. It is recommended as eligible for the NRHP under Criterion C as a rare example of a large stone house in the 1930s in Rockcastle County.

Site RK 44, the Post Office and General Store at Billows, is a two-story shed-roofed, frame structure that was built circa 1900. The site has two outbuildings associated with the property. It is recommended as eligible for listing in the NRHP under Criterion A for its association with the development of commerce in the community of Billows, Kentucky.

5.4.4 Archaeological Impacts

The Cultural Resources investigations described in Chapter 4.4.5 resulted in the identification of 26 archaeological sites impacted by the various Build Alternatives. These 26 sites are considered to be potentially eligible for the National Register of Historic Places (NRHP).

The project area was surveyed between September 29, 2003, and June 11, 2004. The surveys focused on areas of high probability for significant archaeological sites. The proposed I-66 project was comprised of six bands, B, D, G, H, I and KY 80. At the time of the survey mapping was limited to small scale maps (1 inch = 24,000 feet) and alignments had not been formulated. A total of 276 acres was surveyed, and due to the lack of details, an additional 19 acres were surveyed outside the study area.

Prior to this survey, 20 archaeological sites have been recorded within the project corridor's area of study. None of these sites were reinvestigated during the project survey. Examinations of site forms, survey reports and the Office of State Archaeology site database were conducted, and it appears that 16 sites have not been evaluated for the National Register of Historic Places. If these sites are affected by the I-66 project, further archaeological investigation will be necessary. The sites are: 15Pu188, 15Pu216, 15Pu217, 15Pu218, 15Pu219, 15Pu245, 15Pu249, 15Pu253, 15Pu254, 15Pu255, 15Pu257, 15Ll42, 15Ll43, 15Ll71, 15Pu324, 15Pu328. Upon selection of the Preferred Alternate, the appropriate sites as listed above will require further archaeological investigation. The nature of further investigations should be based upon the recommendations provided by the surveyor in the site forms and survey reports in consultation with KYTC. The United States Forest Service shall be consulted for sites that have been recorded within the Daniel Boone National Forest.

The archaeological investigation recorded 26 sites during the survey. Thirteen of the sites were historic cemeteries were found within Band B. All of the cemeteries contain gravesites that are at least 50 years old. Many of the cemeteries include graves dating to the second half of the nineteenth century (1800s). All of these cemeteries may be eligible for listing in the NRHP under Criterion D. The research potential of these sites includes possible information about social status, health, mortuary practices, and ethnicity between the mid nineteenth and mid twentieth centuries in southern Kentucky (preservation could yield useful historical data). If the Preferred Alternative encroaches upon any of these sites, further archaeological investigations for 8 of the sites that have not been evaluated for inclusion into the NRHP will be necessary before the construction phase of the project.

Band D also contained 13 archaeological sites, and 8 have not been evaluated for inclusion in the NRHP. Further investigation will be necessary if the Preferred Alternative impacts any of these sites. The investigation will take place prior to the project's construction phase.

Band G contains 6 sites, and none have been evaluated. Further investigation will be necessary if any of these sites are impacted by the Preferred Alternative.

A total of 3 sites are included within Band H. None of the sites has been evaluated. Further investigation will be required if these sites are impacted by the Preferred Alternative.

Band I contains 9 sites, and have not been recorded. The sites within the right of way limits will require further investigation if the Preferred Alternative is situated within Band I.

The KY 80 Band contains 25 sites, and 20 have not been recorded. Depending upon which alignment is selected as the Preferred Alternative; sites within the proposed right of way will require further investigation.

Within the project area there were archaeological sites that were not surveyed, but may be eligible for the NRHP. The sites not assessed are identified for each of the six bands in Table 5.4.2-1 (on page 5-51), and a summary of eras and data recovered is included below.

Description of Potentially Eligible Sites

Several archaeological sites have been studied previously in Pulaski and Laurel Counties that are situated within or near the project corridors. These studies span a period between 1976 and 2001. Following are summations of the findings of sites that have been identified but not assessed for eligibility in the National Register of Historic Places (NRHP).

Site 15Pu188 consists of an early 20th century farm within the DBNF and the Rockcastle River floodplain. Archaeological remnants consist of a few stone blocks, and a white earthenware sherd with hard paste. No subsurface testing was conducted. The site is considered potentially significant in terms of local history in relation to the Whitaker Mill community. The site has not been assessed for inclusion in the NRHP. This site may be impacted if Alternatives B, B-D, D, KY 80 Modified, or KY 80 Shifted were selected.

Site 15Pu216 is an open habitation prehistoric camp without mounds. It dates to the Middle Archaic period. The site is located in a cultivated field and was surface collected. Six were recovered and included four flakes, a biface and a Middle Archaic stemmed cluster point. This site has not been assessed for inclusion in the NRHP. If KY 80 Modified or KY 80 Shifted is selected as the Build Alternative, this site may be impacted, and further study will be necessary.

Site 15Pu217 is prehistoric, but its age and type are unable to be determined. Located in a cultivated field, the site survey yielded three artifacts – two flakes and a projectile point fragment that appears to resemble a Late Archaic Lamoka relic. The site has not been assessed for the NRHP. It is located within the area of KY 80 Modified and KY 80 Shifted Build Alternatives. If either of these alignments is selected as the Preferred Alternative, further study of this site to determine its eligibility would be required.

Site 15Pu218 consists of a Middle Archaic open habitation (camp) without mounds. The site is located within a cultivated field and was surface collected. A total of 43 artifacts were recovered and included 39 flakes, three bifaces and one Middle Archaic stemmed cluster projectile points. The site has not been assessed for the NRHP. If KY 80 Modified and KY 80 Shifted are selected as the Build Alternative, further study of this site will be required to determine its eligibility.

Site 15Pu219 is a prehistoric site of indeterminate type and age. It is located in a cultivated pasture and field. A total of 21 artifacts were recovered. This site is located near or within the right of way lines of Alternatives B, B-D, D, KY 80 Modified or KY 80 Shifted. If any of these Alternatives are selected as the Build Alternative, further investigations will be required to determine the eligibility of this site for inclusion in the NRHP.

Site 15Pu245 is referred to as the "Hemlock Ledge Shelter," a Middle Woodland rock shelter within the DBNF. Artifacts were recovered from shovel testing and surface collection efforts. A total of 28 flakes, four bifaces, 17 Middle Woodland ceramic sherds, one corn cob fragment, six charcoal fragments and one leather fragment were recovered. The site has been 80 percent disturbed by looting. The site has been recommended for further investigation for its potential to provide further important information about the Woodland culture in the region. The site, which has not been assessed for inclusion in the NRHP, may be impacted in KY 80 Modified or KY 80 Shifted is selected as the Build Alternative.

Site 15Pu249. This Archaic era open habitation site is located within the DBNF. No mounds are evident. A previous survey yielded 39 flakes, a modified flake, one Middle Archaic projectile point, and eight charcoal fragments. This site is considered to have the potential to provide important information about the Archaic culture. It has not been assessed for inclusion in the NRHP. If Alternatives B, D or B-D were selected as the Build Alternative, the site may be impacted, and further study would be required.

Site 15Pu253 This site is an early twentieth century farm/residence within the DBNF. The site includes a 1930s house and associated outbuildings. Other remains included a dump, potbellied stove and bed springs. The site has not been assessed for listing on the NRHP. If Alternatives B, D, B-D, KY 80 Modified or KY 80 Shifted were to be selected as the Build Alternative, further study of this site would likely be impacted, and additional study would be required.

Site15Pu254 This site includes a rockshelter of indeterminate age. It is located within the DBNF. Shovel testing efforts recovered seven flakes. Minor looting was evident in 1991. The site is considered to have the potential to provide important information

about prehistoric culture in the region and therefore may be eligible for the NRHP. If Alternative B, D, B-D, KY 80 Modified or KY 80 Shifted is selected as the Build Alternative, further investigation of this site could be necessary.

Site 15Pu255 includes a nineteenth century farm/residence within the DBNF. This site was investigated in 1991 and includes the remains of a house, and some glass, whiteware and stoneware artifacts. The home was constructed in 1871 and is considered to be potentially significant for its ability to add to the understanding of historic settlement patterns in the area. The site has not been listed on the NRHP. If Build Alternative B, D, B-D, KY 80 Modified or KY 80 Shifted is selected as the Build Alternative, further investigation of this site might be necessary.

Site 15Pu257 includes a prehistoric open habitation without mounds. It is located in the DBNF. Artifacts recovered from shovel testing included five flakes. No further work was recommended from this site, but it may be impacted if Alternative B, D, B-D, KY 80 Modified or KY 80 Shifted is selected as the Build Alternative.

Site 15Pu324 consists of a prehistoric rockshelter of indeterminate age. Recovery efforts included 53 flakes, nine utilized flakes, one sandstone fragment and three animal bone fragments. The significance of this site has not been evaluated. If KY 80 Modified or KY 80 Shifted is selected as the Build Alternative, additional work would be required for this site.

Site 15Pu328 includes a prehistoric open habitation area without mounds. The age is indeterminate. Surface collection efforts included one curvature blade, one biface fragment, two projectile point fragments of indeterminate type, two unifaces, six utilized flakes, 24 flakes, and one abrading stone. Further investigation has been recommended to evaluate the significance of this site. If KY 80 Modified or KY 80 Shifted is selected as the Build Alternative, this site may be impacted.

The following sites were investigated by Cultural Resource Analysts. The results have been included in their October 21, 2004 baseline report.

Site 15Pu473 is a historic cemetery that dates back to the mid 19th century. At the time of the analysis, the most recent burial was in 2000. The cemetery consists of 160 burials, and is possibly eligible for the NRHP. Its eligibility is based on Criterion D for its potential research value in providing information on social status, health, mortuary practices and ethnicity from the mid 19th century through the mid 20th century in southern Kentucky. If KY 80 Modified or KY 80 Shifted is selected as the Build Alternative, further work may be necessary if this site is impacted.

Site 15Pu474 is a historic cemetery dating to the early 19th century. Its most recent burial at the time of the analysis was in 2003. It may be eligible for the NRHP under Criterion D for its potential research value. Information about social status, health, mortuary practices and ethnicity from the early 19th century through the mid 20th century in southern Kentucky may be recovered. If Alternative B is selected as the Build Alternative, this site may be impacted, and further investigation would be recommended.

Site 15Pu476 is a historic cemetery that dates back to the late 19th century. The most recent burial at the time of the investigation was in 2002. A total of 93 burials have been recorded within this cemetery. This site might be eligible for listing in the NRHP for its research value. This site could provide information about social status, health, mortuary practices and ethnicity in southern Kentucky from the late 19th century through the middle 20th century time period.

Site 15Pu470 includes a prehistoric open habitation without mounds, and it is of an indeterminate age. No subsurface prehistoric features were observed during shovel testing, but artifacts were recovered at depths of 50 to 60 centimeters (19 to 24 inches). This site is located within a floodplain and cultural deposits might be buried in alluvium. This would require further work on this site to evaluate the prehistoric component. Further investigation including possible geophysical survey, backhoe trenching, and unit excavation would be required if Alternative D is selected as the Build Alternative. A total of ten 1-m x 1-m (33-ft x 33-ft) test units should be excavated on the results of the geophysical survey and the backhoe trenching.

This site also contains a historic component. No structures are evident within or near the site, and it has been classified as a refuse scatter. The artifacts are mainly of the domestic group and date as early as the 19th century. Some artifacts could be associated with the 20th century. The site remains are not associated with an event or person of regional historic importance. In addition, no artifacts were recovered that are directly associated with structural remains. The artifacts of the historic component appear to represent several decades of dumping activities. No further work is recommended for the historic component on this site.

Site 15Pu475 is a historic cemetery that dates back as early as the mid 19th century with continual use through 2003. Section I of the cemetery consists of 60 burials. Most of these burials are either historic or potentially historic. Section II consists of 84 burials and most are historic or potentially historic. This site could be eligible for listing in the NRHP under Criterion D for its research value. Further investigation of this site could provide information about social status, health, mortuary practices and ethnicity in southern Kentucky. If Alternative D is selected as the Build Alternative this site might be impacted, and further investigation is recommended.

Site 15Pu478 is a historic cemetery dating back as early as the late 19th century. It has been used continually to 2002. The cemetery consists of 38 burials and 20 of these are considered to be historic or potentially historic. This site could be eligible for listing in the NRHP under Criterion D for its research value. Further investigation of this site could provide information about social status, health, mortuary practices and ethnicity in southern Kentucky. If Alternative KY 80 Modified or Alternative KY 80 Shifted is selected as the Build Alternative this site might be impacted, and further investigation is recommended.

Site 15Pu479 is a historic cemetery with dates as early as the late 19th century. The most recent burial was in 1963. The cemetery consists of 53 burials. The site might be eligible for listing in the NRHP under Criterion D for its research value. Investigations of the site could provide valuable information about social status, health, mortuary practices and ethnicity in Southern Kentucky. If Alternative KY 80 Modified or KY 80 Shifted is selected as the Build Alternative, further investigation of this site may be recommended.

Site 15Pu483 consists of a prehistoric open habitation without mounds of the Middle to Late Archaic Age. Many of the artifacts that were recovered were found as deep as 60 centimeters (24 inches) below the surface. The site is on a floodplain, which means that buried intact features or deposits could be present. If KY 80 Modified or KY 80 Shifted were to be selected as the Build Alternative, further investigation would be necessary to determine if the site is eligible for the NRHP. Investigation could include a geophysical survey, backhoe trenching and unit excavation.

Site 15Ll42 This site consists of a prehistoric rockshelter of indeterminate age. It is located within the DBNF. Surface collection efforts resulted in the recovery of one flake and four burned animal bone fragments. No identification was provided for the bones. It was estimated that 10 percent of the area had been disturbed by looting. The site has the potential for additional data recovery and could be impacted if Alternatives G, H, I, KY 80 Modified, or KY 80 Shifted was to be selected as the Build Alternative.

Site 15Ll43 This site is a prehistoric rockshelter of indeterminate age. Surface recovery resulted in the collection of 25 flakes. The site had been 95 percent disturbed. No further work is necessary.

Site 15Ll71 This site is a nineteenth century farm/residence within DBNF. The residence, no longer standing, consists of a foundation, chimney and historic debris (glass and metal fragments that were not collected). The site is considered to be extremely important as a location relating to the late nineteenth/early twentieth century history of the Rockcastle region. This site could be impacted if Alternative G, H, I, KY 80 Modified, or KY 80 Shifted is selected as the Build Alternative. Further investigation would be necessary to determine the eligibility of this site for the NRHP.

Site 15Ll344 This site is a historic cemetery dating back as early as the mid nineteenth century. It has continued to be active through current years. The cemetery consisted of 112 burials at the time of the investigation. This site may be eligible for listing on the NRHP under Criterion D for its research value in relation to social status, health, mortuary practices and ethnicity from the mid nineteenth through the mid twentieth centuries in southern Kentucky. Further investigation of this site would be necessary if Build Alternative G is selected.

Site 15Ll345 is a historic cemetery dating back to the mid nineteenth century, and has been in continual use through current times. A total of 281 burials were recorded at the time of the baseline analysis. Half of these burials were considered to be historic or

potentially historic, and seven date back to the nineteenth century. This site might be eligible for the NRHP under Criterion D for its research value. This site could provide information about social status, health, mortuary practices and ethnicity from the mid nineteenth through mid twentieth centuries. Further investigation of this cemetery could be required if Alternative G is selected as the Build Alternative.

Site 15Ll347 is a historic cemetery dating back to the early 20th century. It is still being used as a cemetery, and consists of 18 burials. It may be eligible for listing in the NRHP under Criterion D for its research value. The site could provide information about social status, health, mortuary practices, and ethnicity from the first half of the 20th century in southern Kentucky. If Alternative G is selected as the Build Alternative, further investigation would be required if this site is impacted.

Table 5.4.2-2 shows the sites assessed but not eligible for consideration on the NHRP.

Table 5.4.2-1 - Summary of Sites Not Assessed with Potential Eligibility for NRHP

Band	Sites Not Assessed – May be Eligible for NRHP
B	15Pu188, 15Pu219, 15Pu 249, 15Pu253, 15Pu254, 15Pu255, 15Pu257, 15Pu474
D	15Pu188, 15Pu249, 15Pu253, 15Pu254, 15Pu255, 15Pu257, 15Pu470, 15pu475
G	15Ll42, 15Ll43, 15Ll71, 15Ll344, 15Ll345, 15Ll347
H	15Ll42, 15Ll43, 15Ll71
I	15Ll42, 15Ll43, 15Ll71, 15Ll 341, 15Ll 342, 15Ll 346, 15Ll 349, 15Ll 350
KY 80	15Ll42, 15Ll 43, 15Ll 71, 15Pu188, 15Pu 216, 15Pu 217, 15Pu 218, 15Pu219, 15Pu 245, 15Pu 253, 15Pu254, 15Pu255, 15Pu257, 15Pu324, 15Pu328, 15Pu473, 15Pu476, 15Pu478, 15Pu479, 15Pu483

Table 5.4.2-2 - Archaeological Sites Assessed but not Eligible for NRHP

	Sites Assessed – Not Eligible for NRHP
B	15Pu138, 15Pu145, 15Pu325, 15Pu472
D	15Pu138, 15Pu145, 15Pu323, 15PU469, 15Pu472
G	No Inventory Sites
H	No Inventory Sites
I	15Ll343
KY 80	15Pu138, 15Pu323, 15Pu325, 15Pu481, 15Pu482